SCIENCE

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MEDALS OF THE NATIONAL ACADEMY OF SCIENCES[1]

INTRODUCTORY REMARKS BY THE PRESIDENT OF THE ACADEMY

FROM time to time endowments have been deposited with the academy in trust for general purposes of the academy and council or for aiding research by grants or for bestowing medals, in some cases with honoraria, upon outstanding American or foreign scientists. There are twenty of these funds, of which eleven are for conferring honors. Each of the honor funds is in the hands of a special committee, which recommends to the academy the recipient it has chosen for any given year. Some of these awards are in recognition of research in special fields, as for instance the Watson Medal for the promotion of astronomical research or the Agassiz Medal for contributions to oceanography.

The history of science has demonstrated that, throughout all recorded time, certain men of the highest intelligence have been dominated by ideas and by ideals of human betterment with quite secondary reference to material rewards. This is written not only in the history of science, but also in other realms of the human understanding and endeavor. May we not, however, claim for science that for some hundreds of years its results have been progressively cumulative, that it has not had to relinquish any territory over which it has once established dominion and that each conquest is a base for new advances. These are the two chief claims of science to be heard in our time. That the methods and the spirit of science can be applied to all kinds of human needs is also one of the beliefs that urges us on to its farther advancement.

Because scientific men have labored so, usually without thought of material reward, for the joy of accomplishment and for the good of humanity, the academy

[1] Presented after the dinner of the academy at the annual autumn meeting held at the University of Chicago on November 16, 17 and 18.

confers its medals for especially distinguished accomplishments in science.

This evening we bestow a medal, in memory of Marcellus Hartley, for eminence in the application of science to the public welfare, and the John J. Carty Medal and monetary award granted not oftener than once in every two years to an individual for noteworthy and distinguished accomplishment in any field of science coming within the scope of the charter of the academy.

The Committee on the Award of the Marcellus Hartley Gold Medal for eminence in the application of science to the public welfare this year decided to recognize the field of public health, but they were unable to distinguish between the merits of two outstanding servants of the public. Accordingly, they recommended a dual award: to Dr. Hugh Smith Cumming, surgeon general (retired) of the United States Public Health Service, and to Dr. F. F. Russell, of the Rockefeller Foundation. I wish that both might have been present together, but Dr. Cumming was absent in Europe at the time of our spring meeting in Washington when the medal was conferred on Dr. Russell, and the award to him has accordingly been deferred until this time.

To our great regret, the chairman of the Committee of Award, Dr. Harvey Cushing, is unable to be present. In his absence our distinguished fellow member, Dr. Ludvig Hektoen, director of the McCormick Institute for the Study of Infectious Diseases and chairman of the National Research Council, will state the reasons that governed the committee in its recommendations.

F. R. LILLIE

PRESENTATION OF THE PUBLIC WELFARE MEDAL TO DR. HUGH SMITH CUMMING

IT is the purpose of the Marcellus Hartley Medal "to mark the appreciation of the National Academy of Sciences for eminent services to the public performed without a view to monetary gains and by methods which in the opinion of the academy are truly scientific." Of the 14 previous recipients of the Marcellus Hartley Medal for eminence in the application of science to the public welfare five have been physicians, four of whom spent their active years in governmental services, federal or municipal, and the fifth partly so. Again the medal is awarded to a physician long in the service of the government.

Hugh S. Cumming was born and educated in Virginia. He studied medicine at the University of Virginia, graduating in 1893. The following year he entered the U. S. Public Health Service as assistant surgeon. Promotions followed, and in 1920 he was appointed surgeon general, which position he held under five successive presidents until January 31, 1936, when he was retired, at his own request, after forty-two years of service.

Dr. Cumming was well prepared to head the Public Health Service by the work and training of his previous assignments. While at Ellis Island he came face to face with the health problems of immigration on a large scale. In charge of quarantine at San Francisco and while in Japan, where he was next detailed, he was in intimate touch with certain diseases against which the United States always has maintained quarantine. After a tour of duty in the Pacific he carried out investigations of the pollution of tidal waters of Maryland and Virginia, of the Potomac watershed and of coastal waters of New Jersey, New York and Delaware. This work gave results of much importance to the understanding and prevention of the pollution of the waters of shellfish and resort areas and its dangers, sanitary as well as industrial.

During the world war Dr. Cumming served first as adviser in sanitation to the Navy; later he was in charge in Europe of activities of the Public Health Service in relation to sanitation, the return of troops and the resumption of trade. While serving as president of the Interallied Sanitary Commission to Poland in 1920 he was called home to be surgeon general.

Only brief mention can be made of some of the important advances in the Public Health Service under Dr. Cumming's leadership. I would recall first the reorganization and expansion of hospital facilities to meet the emergency of temporarily caring for ex-service men and women who were beneficiaries of the War Risk Insurance Bureau, now the Veterans' Administration, a difficult task carried out with expert judgment and foresight. By acquiring to federal control the last state-owned quarantine station in operation, the station at the port of New York, the national quarantine system was completed and unified. The examination by medical officers of the service of intending immigrants to this country prior to their departure from foreign ports was a measure of humanitarian and sanitary significance. An acute need was met by the erection of a hospital for leprosy at Carville, Louisiana, and needed improvements were assured by the provisions for new marine hospitals in various parts of the country. In the prompt control of several outbreaks of bubonic plague within our borders is a striking example of the benefits from the application of science to the prevention of epidemic disease. The creation of a division of mental hygiene, including medical services at penal and correctional institutions under federal control, recognized constructively the mental aspects of the public health. The addition to the corps of commissioned medical officers

of dental, sanitary engineer and scientific personnel was in response to the demands of the expanding activities of the Service. Special mention should be made of the friendly, actively cooperative relations, now well established, between the Public Health Service and the health departments of the various states. In this development, which has resulted in marked improvement in health administration, the influence of Dr. Cumming, wise, modern, clear-sighted, has been of great weight.

On the fundamental and more directly scientific side I can not emphasize too much the growth in the investigative activities and achievements of the Public Health Service in general and as illustrated by the National Institute of Health, formerly known as the Hygienic Laboratory, and by the comprehensive plans for its future growth. We may well be proud of the National Institute. It is a productive center of investigation in its field.

Dr. Cumming has been concerned for many years in international health matters. He has represented the United States on international sanitary conferences; he is now the representative of the Office Internationale d'Hygiéne Publique on the health committee of the League of Nations; he is also the director of the Pan American Sanitary Bureau, a body designed to combat epidemic disease and to improve the health in the countries represented in the Pan American Sanitary Conferences.

A leader in the application of scientific methods to public health, Dr. Cumming has rendered a remarkable public service worthy of conspicuous recognition.

LUDVIG HEKTOEN

RESPONSE OF THE MEDALLIST

No man could help being gratified when given any favorable recognition by such a body as the National Academy of Sciences, and now when you have awarded me such an honor as this, I feel that, whether or not it be deserved, it is more than adequate compensation for a long and interesting life spent in the public service of my country.

Frankly, when I first heard of the award, I thought there must be some mistake, though consolation came with the thought that this body in its search for truth and knowledge has made few errors!

The question in my mind as in yours and in the mind of every thoughtful person is, "What is Public Welfare?"

We all agree with the Roman dictum: "Salus populi suprema lex esto!" But what is it? How may we best attain it?

The desire to help others, to promote the public welfare was not created by or with our generation or country; it runs like a golden thread down the ages in the teachings of great philosophers and the deeds of persons in all walks of life. Some of these teachings and efforts, time and experience have proven unwise, while others have stood the test of changing circumstance.

Unhappily "public welfare" in its narrower as well as broader implications has drawn to its cause not only those intellectually honest, wise, patriotic persons of all classes who have devoted their own lives and possessions to the betterment of humanity but, like other great causes, has attracted an apparently increasing number of camp followers and leaders with mental myopia and strabismus or selfish motives and ambitions, who dissipate public effort or lead it into false paths with strange doctrines, arousing class hatred and distrust, teaching that vice or virtue are class rather than individual attributes, until the term "public welfare" at times has almost an unpleasant connotation.

Is too much stress being placed upon the rights, too little upon the duties and responsibilities of individuals and classes?

Is the petition in the Common Prayer Book, "Lord make us content to do our duty in that state of life in which it hath pleased God to call us," all wrong?

Is the Biblical statement, "Happiness consisteth not in the abundance of riches," one of these truths which time has made uncouth?

Through the ages crimes have been committed, errors made and the progress of humanity toward happiness arrested in the name of high ideals—religion, happiness. Is the same course being followed in the name of "public welfare"?

These questions arise in the minds of thoughtful persons who have been in touch with the unrest and surging here and abroad. "Quo vadis" is in the mind if not on the tongue of each of us.

The acquisition and application of scientific knowledge to methods of production, transportation, domestic life, and no less to medicine in its broader meaning; the consequent increase in total populations and concentration in urban centers, with facilities for rapid movement of peoples and their products—these have perhaps not changed the goal to be reached but have created the necessity for new methods and also, let us hope, the means for the solution of our problems.

As was so ably pointed out at the recent meeting of the British Association, it is to such scientific men as your organization that we should be able to look for assistance in the solution of the problem as to how the accumulated wisdom and knowledge of the arts and sciences may best be used to promote the welfare and happiness of our public.

Such a body will not forget the old Chinese proverb that while "wisdom without knowledge is helpless, knowledge without wisdom is dangerous," nor neglect

to use the lamp of experience in its search for the paths to be followed.

And your assistance will perhaps be more particularly valuable, indeed necessary, in the readjustments necessary in that most important factor, the medical profession and its allies, for medicine in its broader meaning includes all the arts and sciences that may contribute to increasing the mental and physical health of a people.

However much men may differ as to the goal we should strive to attain or the means and methods to be used, all must agree that no people can become or remain great or happy—the public welfare achieved, unless its individuals have sound minds in sound bodies. While we appreciate that all the arts and sciences must contribute to our efforts to reach our goal, nevertheless it is to the medical and its allied professions, especially perhaps to that section devoted particularly to the public health, which by its training, its knowledge of the individual body and mind and its dedication to the task, that we shall be wise in looking for guidance and coordination of effort.

It is because I feel that you wish to show appreciation of their achievements by awarding this great honor to a representative of the profession that I accept it with humility as an individual but with pride as a physician.

As any contribution I have made to public health has been possible only because of the splendid *esprit de corps* of the United States Public Health Service, I am sure that my fellow officers will feel that they have a share in this appreciation of our work.

HUGH SMITH CUMMING

REMARKS BY THE PRESIDENT

THE next medal and monetary award is named after one of our most distinguished and meritorious members, John J. Carty, eminent for his work in telephonic communication, especially wireless, and also transcontinental and transoceanic telephony. It was established by an endowment shortly before his death at the end of 1932; he was the first recipient and was informed of the award, but the actual presentation was made, after his death, to his son at the spring meeting of the academy in April, 1933.

The award this year is made to Edmund Beecher Wilson, Da Costa professor emeritus of zoology in residence at Columbia University, and unofficial dean of zoology in America. This recognition of a long, brilliant and devoted scientific career is a great satisfaction to his many friends, of whom I count myself as one of the chief. The chairman of the committee, Frank B. Jewett, president of the Bell Telephone Laboratories, will state the basis for this award. I have much pleasure in presenting Dr. Jewett.

F. R. LILLIE

PRESENTATION OF THE JOHN J. CARTY MEDAL AND AWARD TO DR. EDMUND BEECHER WILSON

Mr. President: In connection with presenting Dr. Edmund Beecher Wilson to you for receipt of the John J. Carty Medal and Award for the Advancement of Science, voted to him last spring by the academy, it is appropriate that a word both as to the history of the medal and award and Dr. Wilson's qualifications for it should be made. I am happy that it falls to my lot as chairman of the Carty Medal Committee to make these few remarks.

The late General John J. Carty, in whose honor this medal and award were established, was for many years a distinguished member of the National Academy of Sciences. His major activity throughout his active life was concerned with the development of electrical communication. At the time of his death on December 27, 1932, it can be said without fear of contradiction that he was recognized to be the most distinguished communication engineer in the world. This distinction had long been his, and when on June 30, 1930, he retired for age from active service as vice-president of the American Telephone and Telegraph Company, his associates in the Bell System sought for some appropriate way in which to signalize their esteem for him and for his contributions to science and engineering. Recognizing as they did the wide and scholarly sweep of his intellectual and scientific interests and his deep and abiding faith in the value of the National Academy of Sciences as a powerful instrumentality for the advancement of science in the United States, they decided that nothing could be more appropriate nor more pleasing to General Carty than the establishment of a perpetual medal and award in the academy to be named for him.

The result of this decision was that the directors of the American Telephone and Telegraph Company, acting for themselves, the stockholders of the company and the employees, all of whom recognized their great debt to General Carty, gave to the academy the sum of $25,000 to be held in trust, with the income available periodically for the bestowal of a gold medal and a monetary award. In addition to this General Carty's immediate associates in the management of the American Telephone and Telegraph Company, as a token of their particular admiration and esteem, arranged for the design of the medal and the making of the dies needed for striking it.

In order that with the passage of time the medal and award should achieve a real distinction, and because of the catholicity of General Carty's interest in the whole domain of science, the donors in their deed of gift specified only two major requirements. The first and lesser of these requirements was that the medal and

award should not be bestowed oftener than once in two years. As a part of this condition it was specified that with every award the net accumulated income since the time of the last award should be given to the recipient along with the medal and certificate.

The second and major condition specified by the donors was that the award should be to an individual for noteworthy and distinguished accomplishment in any field of science coming within the scope of the charter of the National Academy of Sciences, and should be either for specific accomplishment or for general service in the advancement of fundamental and applied science; and further, that there should be no limitation placed on the individual sought to be honored by virtue of race, nationality or creed. The method of selecting the candidates was to be voted on by the academy and the method of taking such vote was left entirely to the discretion of the academy.

Under the conditions of this deed of gift the academy is assured at all times of complete and untrammeled freedom to bestow this particular honor periodically on any one anywhere and for any achievement in the field of its present or future interest, whenever in its judgment such bestowal is appropriate.

Thus far since its establishment the medal has been bestowed but once, and that through unanimous vote of the academy on General Carty himself. Fortunately this evidence of esteem was made before General Carty's death and was a source of the deepest gratification to him. Unfortunately, presentation of the medal had to be made posthumously.

On this occasion the action of the academy last spring was on the unanimous recommendation of the Carty Medal Committee. This recommendation was made after long and painstaking consideration. In presenting Dr. Wilson to you I feel I can do no better than to quote from the report of the committee as follows:

> In recent years, Professor Wilson has stood preeminent in the field of zoology, and the influence he has had on two generations of biologists is of a very high order. His individual researches on experimental embryology are classical, and his papers on cytology have been fundamental. His great book, The Cell in Development and Inheritance, has perhaps influenced subsequent biological thought more than any other book produced in this country.
>
> In arriving at its present decision to recommend Professor Wilson, the committee has been guided by the terms of the Deed of Gift, which as they relate to the recipient's qualifications read as follows: "The award may be either for specific accomplishment in some field of science, or for general service in the advancement of fundamental and applied science."
>
> In view of his outstanding contributions the committee has no hesitancy in suggesting that Professor Wilson's selection is appropriate both as to specific accomplishment and general service, and we, its members, believe that every consideration points to him as one eminently qualified to receive the Carty Medal.

It is now therefore my very great pleasure to present Professor Wilson for the Carty Medal and Certificate, and its accompanying award, which in this case I understand to have a value of $3,000.

FRANK B. JEWETT

REMARKS BY THE PRESIDENT

IN the absence of Professor Wilson I shall ask Professor Ross G. Harrison, of Yale University, to receive the medal and monetary award which I hereby present, and request him, together with Dr. Jewett, to transmit them to Professor Wilson with the congratulations of the academy on a long life well spent in the service of science, and our best wishes for the fruition of his career and enjoyment of life.

It is customary for recipients of our awards to acknowledge them in a manner always characterized by undue modesty; in this case I shall ask Professor Harrison to speak on behalf of the recipient with the usual cause for such modesty removed.

F. R. LILLIE

RESPONSE ON BEHALF OF THE MEDALLIST

THE rôle in which I am placed this evening is an unusual one in its duality. It is a great pleasure for me to receive the Carty Medal and Award for transmittal to Dr. Wilson, and on his behalf I express to the committee and to the academy his thanks and his high appreciation of the honor they have conferred upon him. At the same time, as a member of the academy, I hasten to add my congratulations to the committee on their admirable choice, and to say, what Dr. Wilson's modesty would preclude him from saying, that no one better qualified to receive this award could possibly have been chosen.

I take it that what you most desire from me is a brief estimate of Dr. Wilson's life work and his place in the science of his time, although in so doing I can not quite separate my own personal relations with him. I first knew Wilson as a tradition. He had preceded me by a decade or so at the Johns Hopkins University, and when I began my biological studies there as an undergraduate in the late eighties, he had some years before received his Ph.D. degree and had already made a substantial reputation as a young professor at Bryn Mawr College. The text-book on biology, written in collaboration with W. T. Sedgwick, was used in our course and its excellence was generally recognized. And so it was with a certain awe that I first looked up to Wilson—a feeling that has long since been tempered by the warmth of friendship. For this I have, perhaps, to thank most the particular circumstances of our association on the editorial board of the *Journal*

of Experimental Zoology now of over thirty years duration. It is to Wilson more than to any one else that we owe the foundation of this enterprise.

Wilson's first extensive piece of work, "The Development of Renilla," was, in its thoroughness and its clarity of exposition, an augury of what was to follow. It was published in the *Philosophical Transactions* of the Royal Society in 1883 and at once won for him a place among embryologists of the time.

However, it was his great work on "The Cell-Lineage of Nereis," published nine years later, that first gave him a world-wide reputation. In this he traced the cleavage of the egg step by step through to the formation of the germ layers and the principal organs of the embryo. He showed that such widely divergent organisms as flatworms, segmented worms and mollusks have a common cleavage pattern, but that corresponding cells in the dividing egg do not always have exactly the same function or fate. This was of great importance in the then much discussed germ layer theory, and threw light on some of the problems of experimental embryology at that time in its infancy. Wilson was not slow to see this and in the year following there appeared his first contribution to this field, "Amphioxus and the Mosaic Theory of Development." In this paper he clearly set forth the antithesis between the mosaic theory of Roux and the epigenetic theory of Hertwig and Driesch, and showed how the two might be reconciled by the recognition of the fact "that the mosaic-like character of the ontogeny emerges from the indifferent condition of the early stages *at different periods in different animals,* and in many cases appears more or less distinctly from the beginning." The views expressed in this paper are as acceptable to-day as on the day they were written. Later Wilson made further notable contributions to experimental embryology, particularly on the development of nemerteans, mollusks and annelids.

Some years ago Wilhelm Ostwald in his interesting book on great men of science (Grosse Männer) classified them, according to their talents, as romantics and classics. Modern psychology would employ, perhaps, less complimentary terms. To the romantic, ideas come thick and fast; they must find quick expression. His first care is to get a problem off his hands to make room for the next. The classic is more concerned with the perfection of his product, with setting his ideas in the proper relation to each other and to the main body of science. His impulse is to work over his subject so exhaustively and perfectly that no contemporary is able to improve upon it. If one may be permitted a zoological comparison, says Ostwald (translated freely), the attitude of the romantic is that of the cuckoo to its eggs, satisfied with having brought them into the world and willingly entrusting their further care to others. The classic, on the other hand, resembles the legendary she-bear that licks her cub into shape with great patience and solicitude and does not let it go until she has done everything possible for it. Leaving the simile, it is the romantic that revolutionizes, while the classic builds from the ground up.

Wilson is a striking example of a classic, and it is interesting to note that for many years his nearest colleague and closest friend was an equally distinguished romantic.

Wilson's qualities as a classic are shown best in his work in cytology, more particularly that on the sex chromosomes, published in the earlier years of the present century. It was only a year or two after the rediscovery of Mendel's laws that the parallelism between Mendelian inheritance and chromosome behavior was pointed out by one of Wilson's students, W. S. Sutton, and it is certain that Wilson had much to do with the development of this idea. Several years later came the discovery of the sex chromosomes, on which Wilson published a long series of papers. A less careful man would have drawn much more sweeping conclusions than he did from this spectacular discovery and might readily have led into grave error. As it was, Wilson's judicial mind immediately saw the pitfalls, with the result that his discovery has been built into the very foundations of the chromosome theory of heredity and will remain as a lasting monument to his genius.

I have spoken only of Wilson's fundamental research. His great book on the cell was the outcome of his studies in cytology and embryology, and this was fittingly appraised before the academy eight years ago by Professor Conklin when the Elliot Medal was conferred. From time to time Wilson has had occasion to give general addresses, and these show the same finish and philosophic insight that characterize his research. With these qualities there is never a lack of vigor and enthusiasm.

In his address as president of the New York Academy of Sciences, delivered in 1904 and entitled "The Problem of Development," which reads, by the way, almost as if written at the present time, he treats of the perennial controversy over vitalism in characteristic manner:

> I am fully in accord with the neo-vitalists in their assertion that the phenomena of development and of life generally have not yet been reduced to a mechanical basis, that they can not at present be fully described in physico-chemical terms. It is certain that living beings exhibit structures more complex than any existing in the inorganic world, and different from them in kind. It is possible, probable I believe, that living bodies may be the arena of specific energies that exist nowhere else in nature. I admit fully that the interpretation of development I have endeavored to outline does not exclude, but

in some ways actually suggests, the existence of such energies. I should, therefore, even admit that the vitalists are wholly right in their contention that the vital processes are not at present explicable as the direct result of such energies as are observed in the non-living world. To prejudge this question would set up a dogmatic barrier to progress, not only in biology, but also in chemistry and physics. If this be vitalism there are probably many of us who must be enrolled as "vitalists," however doubtfully we may regard the honor of bearing such a title. But if the word "vitalism" be used in any other sense than as a convenient phrase, an *X* by which to designate an unknown quantity, if it be taken in a positive sense to imply in the living organism any negation of the fundamental laws of matter and of motion, the existence of any distinctive entity, or principle that does not fall within the chain of physical causation or that contravenes the general laws of physics, then, I protest, to accept "vitalism" as a principle of interpretation is deliberately to abandon the scientific method in biological study.

Again, in an address entitled "Science and a Liberal Education," he characterizes the place of science in our culture as follows:

> The main service of science to our intellectual life is to help preserve us from a certain disorder of the imagination which I will permit myself to speak of as the malady of Peter Bell. I make no attempt to disguise the fact that Peter Bell and his celebrated primrose have begun to show the ravages of time. Even so, I suspect that science will not with impunity lay her desecrating hand upon Wordsworth's parable. And yet that perennial primrose by a river's brim, which through every changeful year
>
> A yellow primrose was to him
> And it was nothing more—
>
> that weather-beaten botanical specimen, I say, symbolizes a kind of mental myopia with which the man of science feels himself to be as much concerned as the poet. Science has a very definite part to play in the treatment of this insidious ailment. It should adjust our vision to the larger meanings of things in the material world. And by this I mean to say *that science should develop—and it should discipline—the constructive imagination.*

Dr. Jewett has said that Dr. Wilson has qualified under both clauses of the deed of gift, *i.e.*, by his specific accomplishment in a field of science and by his general service in the advancement of science. Let me add a third qualification: by service in the general cause of civilization. When we look over the world to-day, with its nationalistic strife and prejudice, which threatens freedom if not civilization itself, when we view our late political campaign with all its extravagant claims, denunciations and promises, we may well wish that the spirit of Wilson's careful search for truth, his scrupulous weighing of evidence, his moderation and caution in drawing conclusions, in short all those qualities that make up the character of our best men of science, might enter more fully into affairs of politics and government.

ROSS G. HARRISON

OBITUARY

JAMES NEWTON PEARCE

WHILE waiting in the Iowa stadium for the opening of a football game, which was his favorite sport, Professor James Newton Pearce died suddenly of a heart attack on Saturday, November 14, 1936. His passing was a profound shock to his colleagues and friends. For some time past those of us who had been in daily contact with him were fearful that his general health had been impaired by an attack of appendicitis which he suffered a few years ago. But in view of the fact that he had since that time carried a regular schedule of work with his accustomed zeal and energy, no one knew that he was in any immediate danger.

James Newton Pearce was born at Oswego, Illinois, on December 21, 1873, the son of James Titsworth and Mary Catherine (Gannon) Pearce. He received the degree of Ph.B. from Northwestern University in 1896, and that of Ph.M. in 1897. During the ten years following his graduation he was successively chemist for James S. Kirk and Company, soap manufacturers of Chicago, graduate student at the University of Chicago, instructor in chemistry at Northwestern and graduate student at Johns Hopkins University, where he received the degree of Ph.D. in 1907.

Dr. Pearce was a member of Phi Beta Kappa, Sigma Xi, Gamma Alpha, the American Chemical Society and the American Association of University Professors. He was a fellow of the American Association for the Advancement of Science and the Iowa Academy of Science. He had served as chairman and councilor of the Iowa Section of the American Chemical Society. For the past nine years he had been a member of the committee on contact catalysis of the National Research Council and a member of the board of editors of the *Journal of Physical Chemistry* for 1932–33.

Dr. Pearce's interest in chemistry began in his undergraduate days and was emphasized by a short period of industrial work, a few years as a teacher of chemistry, then a period of graduate study. This interest was broadened and intensified by his work in the laboratory of Professor Harry C. Jones at Johns Hopkins, and it may be said that his experience there determined in large measure the direction of his life

work. His publications include more than 50 titles, and nearly all of them deal with the properties of solutions of electrolytes, the adsorption of gases and the development of apparatus required to test the reactions involved.

Dr. Pearce went to the University of Iowa in 1907 as assistant professor and was placed in charge of physical chemistry. He was made associate professor of physical chemistry in 1919 and professor in 1920. His enthusiasm as a teacher and his insight as a research worker attracted a large number of graduate students. To them he gave unsparingly of his time and energy. He worked long hours in the laboratory and went home to write reports and read proof. It was his habit to give students an opportunity to develop initiative, and he judged them finally by their ability to work independently. Nevertheless, he was always ready with advice and counsel. His interest in his students did not cease when they left his laboratory. On the contrary, one of his greatest delights was to greet them again at home-coming, at a meeting of the American Chemical Society or at some similar gathering.

Dr. Pearce gave twenty-nine years of devoted service to the department of chemistry of the University of Iowa. Few have served longer in a single academic post, and none more faithfully than he.

L. CHAS. RAIFORD

SCIENTIFIC EVENTS

THE SECTION OF MEDICINE AND SCIENCE OF THE PARIS EXPOSITION

ACCORDING to present plans for the International Exposition in Paris in May, 1937, announced by the French High Commissioner, three large pavilions will be devoted to medicine and science. Special emphasis will be placed on the precise scientific character of modern medicine as compared to the hit-or-miss methods of the nineteenth century. It is planned that the exhibit, which it is expected will be of special interest to members of the medical and allied professions, will be so arranged and displayed as to be easily understood by the layman.

Professor A. Gosset, an authority in applied medicine, and Professor G. Roussy, pathologist, will be in charge of the scientific medical division. Both clinical practice and research work will be included in the exhibit.

The three halls, each dedicated to a great name in French medical history, will be devoted to the illustration of the various phases of medicine and allied sciences. The Claude Bernard Pavilion will contain, among many other exhibits, a transparent man, illuminated to show the glands, nervous system and general anatomy. Another of the halls will be called the Laennec Pavilion. In this building will be shown an important collection of instruments, books and relics of nineteenth century medicine, with a display of modern medical instruments and equipment, illustrating the advances of the past fifty years in the science of medicine. The exhibits will be arranged chronologically to demonstrate steps in the history of medical progress. Every branch of medicine will be represented and in many cases treatment for certain diseases will be demonstrated. Moving pictures will be employed to show scientific experiments, research into the causes of infection and illness and methods of treatment.

In addition to presenting a comprehensive view of medical history and present-day practice, insight into the probabilities of medical science of the future will be afforded and advances made through scientific research will be demonstrated. Governmental regulation of sanitation will be stressed and the necessary contribution of industry to the elimination of disease will be emphasized.

INTERNATIONAL EXHIBITION OF APPLIED AND SCIENTIFIC PHOTOGRAPHY

AN International Exhibition of Applied and Scientific Photography will be held in Rochester in March, 1937, under the sponsorship of the Rochester Scientific and Technical Section of the Photographic Society of America. The objective of the exhibition will be to show examples of the application of photography to the various branches of science and technology.

The following sections have been organized:

I. Color Photography: (a) processes in detail; (b) transparencies; (c) prints.
II. Astronomy and Metrology.
III. Aerial Photography.
IV. Photomicrography: (a) metallography; (b) other subjects.
V. Medical Photography: (a) prints; (b) radiographs; (c) motion pictures.
VI. X-Ray in Industry.
VII. Documentary Photography: (a) small film library work; (b) instrument reading; (c) miscellaneous.
VIII. High Speed Photography.
IX. Stereo-Photography: (a) prints; (b) transparencies; (c) motion pictures.
X. Photography in Physics and Chemistry: (a) x-ray spectrography; (b) cosmic and other ray effects; (c) miscellaneous.
XI. Photographic Sensitivity: (a) photographic effects; (b) light-sensitive substances.
XII. Natural History.
XIII. Miscellaneous.

Photographs or apparatus showing the applications of photography to typical problems in any branch of science and technology will be welcomed. All correspondence in regard to the exhibition or requests for entry blanks should be addressed to the secretary, C. B. Neblette, Department of Photographic Technology, Rochester Athenaeum and Mechanics Institute, Rochester, New York.

THE AMERICAN STANDARDS ASSOCIATION

AT the annual dinner of the American Standards Association a review of the work for the year was given by Dana D. Barnum, president of the Boston Consolidated Gas Company. He reported that the codes had brought about a large degree of uniformity among the various states, not only to the benefit of employers, but to industrial and insurance groups as well.

During the year 33 new standards and 33 revisions of standards previously adopted were approved. This brings the total of American standards to 357 in the fields of civil, mechanical and electrical engineering, metallurgy, chemistry, textiles, oil and paper and other industries.

Marking virtual completion of a project started in 1927, new American standards approved this year now classify coals from peat to anthracite. This undertaking, which will make possible the scientific purchase of coal, is by far the most comprehensive of the kind ever carried out, and represents $100,000 spent on research by the United States and Canadian governments alone.

Three new standards in the field of sound measurement and nomenclature of sound will prove valuable to both engineers and musicians. One of these has resulted in a new "noise meter" to measure the sound of typewriter or pneumatic drill. It may also be used in music studios to teach singers how to place their voices most effectively for radio, movie and concert work. Before this specification became available there were five meters on the market the results of which were in no way comparable.

An international standard for 16-mm sound-film now provides for complete interchangeability of this size film and equipment throughout the world, ending a two-year controversy between European and American manufacturers with universal adoption of the American practice.

Increased attention to problems of traffic safety during the year have resulted in various new projects. Safety standards for buses and trucks, which were developed last winter at the request of the Interstate Commerce Commission, have since been used by that commission as a basis for public hearings. Standard specifications for safety glass have been developed, and work is underway on standards to determine the "roadability" of motor vehicles.

Five national organizations have joined the association during the year. This brings its total membership to fifty-six national organizations, including technical societies, trade associations and departments of the federal government; and some 1,800 companies. The new members are: Industrial Safety Equipment Association, Metal Lath Manufacturers Association, National Association of Motor Bus Operators, Association of Gas Appliance and Equipment Manufacturers, American Gear Manufacturers Association.

SYMPOSIUM ON EARLY MAN AT THE ACADEMY OF NATURAL SCIENCES OF PHILADELPHIA

PLANS for an international Symposium on Early Man and the Origins of the Human Race, which will be attended by scientific men from Java, Europe, China, South Africa and America, to be held at the Academy of Natural Sciences of Philadelphia in conjunction with the celebration of the one hundred and twenty-fifth anniversary of the founding of the academy on March 18, 19 and 20, 1937, were announced on December 19.

Invitations to scientific men here and abroad will be sent in January, when plans for the symposium program have been completed. Foreigners already known to be coming to the symposium include Dr. Pierre Teilhard de Chardin, of China; Dr. Ralph Von Koenigswald, of Java; Dr. R. Broom, of South Africa; Dr. Dorothy A. Garrod, of England, and Dr. Kaj Birket-Smith, of Denmark.

A committee headed by Dr. John C. Merriam, president of the Carnegie Institution of Washington, D. C., is in charge of developing the program of the Symposium on Early Man. Other members of this committee are Dr. Edwin G. Conklin, vice-president of the academy and president of the American Association for the Advancement of Science; Dr. George Grant MacCurdy, director of the American School of Prehistoric Research; Dr. Hellmut De Terra, research associate of the Carnegie Institution, assigned to the academy, and Dr. Edgar B. Howard, a trustee of the academy and acting curator of the academy's newly reestablished department of geology and paleontology, who will act as secretary of the symposium committee.

The program will include the presentation of original papers by leading authorities in the various fields contributing to the study of ancient man and pre-history, representing research in geology, paleontology, archeology, physical anthropology and other related sciences.

Of special interest will be the "Hall of Pre-History,"

featuring exhibits of ancient man found in all parts of the world. At the academy there will be assembled in one hall all the present available fossil remains, weapons and tools as well as replicas of the sites on which these discoveries have been made.

Though final arrangements have yet to be consummated, Dr. Ralph Von Koenigswald will bring a cast of the earliest datable human fossil, "Homo Modjokertensis," Dr. Pierre Teilhard de Chardin will bring casts of recently unearthed remains of "Peking Man" and Dr. A. E. Jenks will contribute to the exhibition human skeletal remains found in Minnesota. At one end of the hall there will be a reproduction of the site at Clovis, New Mexico, where last summer Dr. Howard found the tools and stone points of the so-called "Folsom Man" in conjunction with the bones of extinct mammoths.

The one hundred and twenty-fifth anniversary of the Academy of Natural Sciences of Philadelphia, to be marked by the Symposium on Early Man, will commemorate the founding of the oldest institution of its kind on the American continent. In its earliest years, the academy was known to European scientists as the "Lyceum of America" and the scientific gateway to a virgin field. The institution has been a pioneer in many fields of natural history. During the past year more than twenty-six expeditions and field trips to all parts of the world have gone out from the academy; new work in geology and in the study of ancient man has been undertaken and a new department of education has been organized.

BROADCASTS BY THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE program of radio broadcasts arranged for the meetings of the American Association for the Advancement of Science at Atlantic City and Philadelphia is as follows:

December 28, Monday, 7:30 to 7:45 P. M.
E. G. Conklin, Princeton University, president of the American Association for the Advancement of Science. Topic: "Science and Human Welfare."

December 29, Tuesday, 6:00 to 6:15 P. M.
A. H. Compton, University of Chicago, sponsor. Topic: "Science in the News."

December 30, Wednesday, 5:00 to 5:15 P. M.
A. E. Hitchcock and P. W. Zimmerman, Boyce Thompson Institute. Topic: "How Do Plant Hormones Act?"

December 31, Thursday, 6:00 to 6:15 P. M.
Howard Blakeslee, David Dietz and John O'Neill, New York newspapers. Topic: "Science and the Press."

January 2, Saturday, 6:00 to 6:15 P. M., Philadelphia.
Otis W. Caldwell, Boyce Thompson Institute; Watson Davis, Science Service; Franklin Dunham, National Broadcasting Company. Topic: "The Week of Science Meetings."

Columbia Broadcasting Company

December 28, Monday, 2:30 to 2:45 P. M.
Howard E. Enders, Purdue University; Otis W. Caldwell, Boyce Thompson Institute; Evelyn M. Fansler, Atlantic City High School Science Clubs, and Alton Meister, New York City High School Science Clubs. Topic: "The Science Youth Movement."

December 29, Tuesday, 2:30 to 2:45 P. M.
Watson Davis, Science Service. Topic: "The Year in Science."

December 30, Wednesday, 2:30 to 2:45 P. M.
F. B. Knight, University of Iowa. Topic: "Is Education a Science?"

ELECTION OF OFFICERS OF THE AMERICAN CHEMICAL SOCIETY

DEAN FRANK C. WHITMORE, of the School of Chemistry and Physics of Pennsylvania State College, has been elected president of the American Chemical Society for 1938. He will take office as president-elect on January 1, succeeding Dr. Edward R. Weidlein, director of the Mellon Institute of Industrial Research, who will become president. Dr. Weidlein succeeds Professor Edward Bartow, of the State University of Iowa.

Other officers elected were:

Directors: Professor Townes R. Leigh, acting vice-president of the University of Florida—director for the fourth district to succeed Professor E. Emmet Reid, of the Johns Hopkins University; Professor Robert E. Swain, head of the department of chemistry in Leland Stanford University—director for the sixth district to succeed Dr. Walter A. Schmidt, of Los Angeles; Dr. Willard H. Dow, president of the Dow Chemical Company, Midland, Mich., —director at large to succeed Dr. Milton C. Whitaker, of New York.

Councilors at Large: Dr. E. K. Bolton, chemical director of E. I. du Pont de Nemours and Company; Professor W. L. Evans, of the Ohio State University; Professor Edward Mack, Jr., head of the department of chemistry of the University of North Carolina; Dr. C. E. K. Mees, vice-president and director of research, Eastman Kodak Company.

Dean Whitmore was recently awarded the William H. Nichols Medal of the New York Section of the American Chemical Society, one of the highest honors in chemical science, "for his studies in metallo-organic compounds, especially those of mercury, and in the field of aliphatic chemistry, particularly in molecular rearrangements and in the polymerization of olefins." He will receive the medal, founded in 1902 to stimulate original research in chemistry, at a ceremony on March 5, 1937.

Before becoming dean of the school of chemistry and

physics at Pennsylvania State College in 1929, Dr. Whitmore was instructor in organic chemistry at Williams College and at Rice Institute, assistant professor at the University of Minnesota and professor and head of the chemistry department at Northwestern University.

He is consultant and member of the Scientific Advisory Committee of the Chemical Warfare Service. He has held many offices in the American Chemical Society, starting with the treasurership of the Southeast Texas Section in 1917, and including nine years of service as a national director and eight years as secretary and chairman of the Division of Organic Chemistry. He was a vice-president of the American Association for the Advancement of Science in 1932. He has also been chairman of the Division of Chemistry and Chemical Technology of the National Research Council and a member of other divisions of that organization.

AWARD OF THE CHARLES FREDERICK CHANDLER MEDAL

THE sixteenth award of the Charles Frederick Chandler Medal of Columbia University has been made for 1936, the centennial of Chandler's birth, to Dr. John Howard Northrop, of the Rockefeller Institute for Medical Research. Dr. Northrop, who will deliver the annual Chandler lecture next spring, was cited for fundamental discoveries concerning bacteria, the constitution of protein and the chemistry of digestion.

The medal was founded in 1910 to honor Chandler, called the father of the American Chemical Society, who was born on December 6, 1836, and who, for more than half a century, accomplished pioneer work in industrial chemistry, advanced public health and directed the teaching of chemistry at Columbia.

Dr. Northrop received the degree of bachelor of science from Columbia in 1912, the master of arts in 1913 and the doctorate in 1915. He held the William Bayard Cutting Travelling Fellowship in 1915–16. He has been associated with the Rockefeller Institute since 1916, becoming a member in 1924. During 1918–1919 he served as captain in the Chemical Warfare Service. He is a member of the editorial board of the *Journal of General Physiology* and of the National Academy of Sciences. He received the Stevens Prize of the College of Physicians and Surgeons in 1931, and Harvard University conferred upon him the honorary degree of doctor of science during the Tercentenary Celebration last September.

Previous recipients of the Chandler Medal include Leo H. Baekeland, William A. Hillebrand, Willis R. Whitney, F. G. Hopkins, Edgar R. Smith, R. E. Swain, E. C. Kendall, Samuel W. Parr, Moses Gomberg, John Arthur Wilson, Irving Langmuir, James Bryant Conant, George O. Curme, Jr., Jacob Goodale Lipman and William F. Giauque.

Besides Professor Thomas, Professer Leo H. Baekeland and Professor Arthur W. Hixson are members of the Chandler Lectureship Committee.

In making public the award Dr. Butler said in part:

> Columbia University could not let the one hundredth anniversary of the birth of Professor Charles Frederick Chandler go without recognition and grateful acknowledgment of his outstanding scientific and university service.
>
> In 1864 Chandler came to Columbia as one of the group which planned the establishment of the famous School of Mines, the first of its kind in the United States. His associates were Professor Thomas Egleston and General Francis Laurens Vinton. From that time he remained at the head of the department of chemistry at Columbia until his retirement in 1911. His eager and many-sided personality led him into various forms of public service, in each of which he distinguished himself.
>
> He was dean and executive officer of the School of Mines for a third of a century, and in addition taught chemistry to the students of medicine at the College of Physicians and Surgeons, and served as Health Officer of the City of New York. He built many monuments, some of them visible and some invisible, but all of an excellence and a distinction which have made his name a memorable one.
>
> Columbia University, in its every part, held his personality in warm affection and will always hold his memory in highest honor and gratitude.

SCIENTIFIC NOTES AND NEWS

DR. AMBROSE SWASEY, the distinguished mechanical engineer, chairman of the board of directors of Warner and Swasey, Cleveland, Ohio, celebrated his ninetieth birthday on December 19.

BRIGADIER-GENERAL DAVID LEGGE BRAINARD, retired, known for his Arctic explorations, celebrated his eightieth birthday on December 21.

LEADERS in military and civil aviation, including members of the National Advisory Committee for Aeronautics, honored Wilbur Wright and Orville Wright on the thirty-third anniversary of the first flight by Orville Wright at Kittyhawk, N. C., on December 17, 1903. A wreath was placed on the grave of Wilbur Wright, and personal greetings, including a message from President Roosevelt, were presented to Orville Wright at his home. Those present included Dr. Joseph S. Ames, chairman of the National Advisory Committee for Aeronautics, and Dr. Charles G. Abbot, secretary of the Smithsonian Institution.

THE Laveran Gold Medal of the Société de Pathologie Exotique of Paris has been conferred upon Dr. A. W. Sellards, associate professor of tropical medicine at the Harvard University Medical School. Dr. Sellards has been associated with French investigators in the study of yellow fever since 1927. This work has culminated in the development of an effective vaccine which has now been employed for the protection of more than 20,000 persons.

A CORRESPONDENT writes: "In recognition of the long and unusually productive career of Dr. George A. Campbell in telecommunication, it has been decided to reprint his more important scientific and engineering papers in a commemorative volume. Dr. Campbell retired recently from active service as research engineer of the American Telephone and Telegraph Company. Among his contributions are the electric wave-filter, the anti-sidetone telephone circuit and the four-wire repeater circuit. The volume of collected papers is being printed privately by the American Telephone and Telegraph Company, and distribution will be handled through the editorial office of the *Bell System Technical Journal.*"

AT a meeting of the Rittenhouse Astronomical Society of Philadelphia, held on December 11 at the Franklin Institute, honorary membership was conferred upon Robert R. McMath, director of the McMath-Hulbert Observatory of the University of Michigan, in recognition of his contributions to astronomy through the medium of motion pictures. Mr. McMath then spoke to the society on his work and showed his latest motion pictures of solar prominences.

DR. ALEXANDER WETMORE, assistant secretary of the Smithsonian Institution, has been designated correspondent of the Museum of La Plata.

THE annual distinguished service medal of the American Farm Bureau has been awarded jointly to Senator George W. Norris, of Nebraska, and Henry A. Wallace, Secretary of Agriculture.

THE Massachusetts Horticultural Society has awarded its gold medal to Norman Taylor, formerly curator of plants at the Brooklyn Botanical Garden, with the citation, "For your work in editing 'The Garden Dictionary,' considered to be the most notable horticultural book which has appeared in America in recent years."

A BANQUET was given on December 12 in honor of Dr. Guy Y. Williams, head of the department of chemistry at the University of Oklahoma, in recognition of his thirty years of service to the university. Members of Alpha Chi Sigma and the American Institute of Chemical Engineers sponsored the tribute; students, faculty members and alumni attended the banquet.

THE Board of Canvassers of the American Pharmaceutical Association, composed of Edward Spease, *chairman;* Edward D. Davy, and F. J. Bacon, all of Cleveland, Ohio, has announced, as the result of the mail ballot for the officers of the association, the election of the following: *President Elect,* E. N. Gathercoal, Chicago; *First Vice-President Elect,* W. Mac Childs, Eldorado, Kansas; *Second Vice-President Elect,* Glenn L. Jenkins, Minneapolis; *Members Elect of the Council,* H. A. B. Dunning, Baltimore; S. L. Hilton, Washington, D. C., and P. H. Costello, Cooperstown, N. Dak.

OFFICERS of the Rittenhouse Astronomical Society of Philadelphia have been elected as follows: W. Herbert Fulweiler, of Wallingford, Pa., *president;* Dr. John H. Pitman, of the Sproul Observatory, *vice-president.* A. Clyde Schock and Sigurd W. Johnson were reelected secretary and treasurer, respectively. James Stokley, associate director of the Franklin Institute, in charge of astronomy, was elected a member of the Board of Governors.

DR. JOHN W. GOWEN, research geneticist at the Rockefeller Institute for Medical Research at Princeton for the past ten years, has been appointed professor of genetics at the Iowa State College.

FRANCIS SCHUMACHER, senior silviculturist and chief of the section of forest measurements in the United States Forest Service since 1930, has been appointed professor of forestry at Duke University, effective on July 1.

JOHN W. THOMPSON, assistant physician at the Royal Hospital, Edinburgh, Scotland, formerly lecturer in physiology at Swarthmore College and demonstrator in physiology at the University of Edinburgh, has been appointed an assistant in the Harvard Fatigue Laboratory for the remainder of the academic year.

DR. LAWRENCE WADE BASS has been appointed a member of the executive staff of Mellon Institute of Industrial Research. He served as executive assistant at Mellon Institute from 1929 to 1931 and is returning to that organization as assistant director after having been connected with the Borden Company, New York, as director of research. He will assume his work at the institute on January 1.

THE Engineering Foundation, with the sponsorship of the American Institute of Electrical Engineers, has appropriated $5,000 for experimental research on the "Stability of Impregnated Paper Insulation." The work is to be done in the School of Engineering of the Johns Hopkins University under the direction of Dr. J. B. Whitehead, professor of electrical engi-

neering. It is expected that the present program will be extended through a second year.

THE trustees appointed under the trust set up by Lord Nuffield to administer his gift of £2,000,000 for medical research at the University of Oxford are W. M. Goodenough, who will act as chairman (appointed by Lord Nuffield); the vice-chancellor (*ex-officio*); Sir Farquhar Buzzard, Professor Johnston and R. W. Thornton (appointed by Lord Nuffield); the registrar of the university (appointed by the Hebdomadal Council); Dr. Edward Mellanby (appointed by the board of the Faculty of Medicine); Andrew Walsh and Major R. C. Rowell (appointed by the Radcliff Infirmary), and A. H. Wood (appointed by the Wingfield Morris Orthopedic Hospital).

THE Laboratory of Industrial Hygiene has been incorporated under the laws of the State of New York as a non-profit organization empowered to carry on scientific and industrial work in chemical, bacteriological and, in general, public health problems, to accept grants for definite scientific purposes, etc. Its officers include Dr. William Hallock Park, *president;* Miss Grace McGuire, *secretary,* and Dr. K. George Falk, *vice-president and treasurer.* Its staff includes Miss Grace McGuire, in charge of chemical work; Mrs. Eugenia Valentine Colwell, in charge of bacteriological work; Dr. K. George Falk, director; Dr. William Hallock Park, consultant, and a number of assistants. The laboratory includes at the present time the following units: (1) Certified Milk Laboratory under the direct supervision of Dr. Park; (2) Vitamin Testing Laboratory; (3) Clinical Diagnostic Laboratory; (4) Chemical Laboratory, and (5) Bacteriological Laboratory.

ARRANGEMENTS have been concluded with Dr. Isaiah Bowman, president of the Johns Hopkins University and fellow of the Geological Society of America, for an address to be given at the annual dinner of the society on December 30. Because of the inability to engage broadcasting facilities at that time, it has been arranged for Dr. Bowman to give his address to the larger audience of the air on Wednesday afternoon from 2:00 to 2:15 (E. S. T.) over Station WLW. His subject is to be "Geology in the Evolution of Culture."

DR. C. E. KENNETH MEES, director of research of the Eastman Kodak Company, delivered the first John Howard Appleton lecture for the year 1936–37 in the Metcalf Auditorium, Brown University, on Friday evening, December 18. His subject was "Color Photography." The lecture was illustrated by colored lantern slides and color movies.

THE third lecture in the Smith-Reed-Russell series for this year at the School of Medicine, the George Washington University, was given on December 15 by Dr. Thomas Parran, Jr., Surgeon General, U. S. Public Health Service, who spoke on "The Enlarging Opportunities for a Career in Public Health."

DR. BENO GUTENBERG, professor of geophysics and meteorology in the California Institute of Technology, gave an illustrated lecture on "Earthquakes" before the Chapter of the Society of the Sigma Xi of the University of California at Los Angeles on December 2.

PROFESSOR TULLIO LEVI-CIVITA, of the University of Rome, gave a lecture on December 3 on "A New Deal for the Elementary Foundations of Relativity," before the Mathematics Club, conducted jointly by the departments of mathematics of Bryn Mawr College, Haverford College, Swarthmore College and the University of Pennsylvania.

LORD RUTHERFORD and Lord Horder were the speakers at the opening of the Mozelle Sassoon high voltage x-ray therapy department of St. Bartholomew's Hospital, London, on December 10.

THE first International Conference on Fever Therapy will hold its sessions on March 29, 30 and 31, 1937, at the College of Physicians and Surgeons, Columbia University, New York City. The first day will be devoted to the discussion of physiology, pathology and methods of production of fever. Dr. Frank W. Hartman, Henry Ford Hospital, Detroit, Michigan, is chairman of the committee arranging this section of the program, and Dr. Charles A. Doan, of Ohio State University, is secretary. The second day is to be spent in the consideration of miscellaneous diseases treated by fever, such as chorea, rheumatic carditis, ocular diseases, arthritis, leprosy, meningococcus infections, undulant fever, tuberculosis, tumors, skin diseases, etc. This session will be arranged by Dr. Clarence A. Neymann, of Chicago, with the assistance of Dr. Frank H. Krusen, of the Mayo Clinic, as secretary. The morning of the third day is to be devoted to the consideration of syphilis. Dr. Walter M. Simpson, Miami Valley Hospital, Dayton, Ohio, is chairman of this section, which has as its secretary Dr. Leland E. Hinsie, New York State Psychiatric Institute, New York City. In the afternoon of the same day, the treatment of gonorrhea by fever is to be discussed under the chairmanship of Dr. Stafford L. Warren, Strong Memorial Hospital, University of Rochester, Rochester, N. Y. The secretary of this committee is Dr. Charles M. Carpenter, Rochester, N. Y. Baron Henri de Rothschild, of Paris, is general chairman of the International Conference on Fever Therapy. Dr. Walter M. Simpson, Dayton, Ohio, is chairman of the American committee. All who plan to attend the conference are urged to register

promptly with the general secretary, Dr. William Bierman, 471 Park Avenue, New York City. The registration fee is $15.00.

THE post-doctorate fellowships in the biological sciences (zoology, botany, anthropology, psychology, agriculture and forestry), available through the National Research Council for the academic year 1937–38, will be awarded by the Board of National Research Fellowships in the Biological Sciences at a meeting which is to be held the latter part of April. Applications should be filed with the office of the board by February 15, 1937. Appointments may be made prior to the conferring of the doctor's degree, to be effective upon the receipt of the degree within six months. Application blanks and statement of conditions will be furnished upon request by the secretary, Board of National Research Fellowships in the Biological Sciences, National Research Council, Washington, D. C.

THE Committee on Scientific Research of the American Medical Association invites applications for grants of money to aid in research on problems bearing more or less directly on clinical medicine. Preference is given to requests for moderate amounts to meet specific needs. For application forms and further information, the committee should be addressed at 535 North Dearborn Street, Chicago, Illinois.

NEW premises for the research laboratories of the British Institution of Automobile Engineers have been acquired on the Great West Road, Brentford, near the Firestone factory. According to the London *Times*, the front of the building is imposing, the two-story block housing the general offices, library and committee room, while at the rear there are sections for physical and chemical testing of materials, a bay for testing complete vehicles and another for the simultaneous testing of as many as eight engines. Beyond a car park there is a further building containing the stores, workshop and another bay where several independent researches can be undertaken. The premises are now being fitted out, and it is hoped that they will be opened in the early spring. Most of the investigations sponsored by the institution have been carried out at the Chiswick laboratories, which consist of a large private house with a workshop at the rear. These premises have served their purpose well, but it became obvious during the past year that a move would have to be made to more modern premises. The rapid development of the institution's research activities is illustrated by the fact that four years ago there was only one item on the program of research, whereas now there are ten. During the same period the number of manufactures and vehicle operators affiliated to the institution has increased from 28 to 180.

DISCUSSION

SIGNIFICANT FIGURES IN STATISTICAL CONSTANTS

PROFESSOR JOSEPH BERKSON'S discussion, under the above heading, in the November 13 number of SCIENCE pertains to a subject with respect to which there has been a great deal of misunderstanding. More than twenty years ago, however, I published a paper (in the *American Mathematical Monthly*, 1913, vol. 20, p. 242) in which I explained in detail the reason for the properties of the solutions of linear equations which Professor Berkson notes. Since my paper is not now readily accessible to many who may be interested in the subject, I will repeat its conclusions, without entering into proofs.

In order to make my statements as concrete as possible, I will relate them to the linear equations

$$a_1x + b_1y + c_1z = n_1,$$
$$a_2x + b_2y + c_2z = n_2,$$
$$a_3x + b_3y + c_3z = n_3,$$

in which a_1, b_1, . . . etc., and n_1, n_2, and n_3 are given numbers, and from which x, y and z are to be determined. In practical problems the coefficients a_1, b_1, . . . etc., and the right members n_1, n_2 and n_3 will be known approximately; that is, to some number of significant figures. For the purpose of illustration here, it will be assumed that they are all given to six significant figures.

There are two questions to be answered: (1) Are x, y and z determined by the equations, and if so, (2) to how many significant figures? The answer to the first question is given in every algebra. It is: The equations have a solution, and only one, for x, y and z if the determinant of the coefficients a_1, b_1, . . . etc., is not zero. (If the determinant is zero, at least one of the quantities x, y, z may be assigned an arbitrary finite value.)

The answer to the second question is that the number of significant figures in the solution for x, y, z can not exceed the number of significant figures in the determinant of the coefficients a_1, b_1, . . . ,but usually equals the number of significant figures in the determinant. To illustrate, suppose the determinant of the coefficients of the given equations has only three determined significant figures. Then, although the coefficients a_1, b_1, . . . and the right members n_1, n_2, n_3 are all given to six significant figures, the values of x, y and z are not determined by the equations beyond three significant figures, and the retaining of a large number of places in the calculations can not improve the results.

Perhaps it is advisable to make a few comments on

the determinant of the coefficients. It is a sum of six products, each of three of the coefficients, of which $a_1b_2c_3$ is one. Since by hypothesis each of the coefficients is given to six significant figures, the product is determined to six significant figures (and possibly one or two more when the product of the leftmost digits of a_1, b_2 and c_3 exceeds 9 or 99). Although each of the six products is determined to six significant figures, their sum may be determined only to a smaller number of significant figures. For example, suppose the six products are .346215, −.178243, −824171, .129572, .238847, .287416. The sum of these six numbers is −.000364, which is the value of the determinant so far as it can be determined. In this case, x, y and z are not determined by the equations beyond three significant figures.

Professor Berkson states that in certain cases he has found it necessary to retain many places in his calculations in order that his solution, as found, may have as many significant figures as his original equations. By whatever steps he may have carried out his calculations, in all such cases the determinant of his equations contained fewer significant figures than the given constants of his original equations. His results beyond the number of significant figures in the determinant of his original equations were wholly illusory, and much of his laborious calculation, which might easily have been ten times as costly as they would have been under an adequate theory, was wasted.

As has been stated, the solution of the foregoing equations, under the conditions assumed, is determinate only to three significant figures. But by such calculations as Professor Berkson has used, values of x, y and z to six places can be obtained. The extra three figures, however, have no real significance, for other solutions differing in the last three places and exactly satisfying the equations to six figures can also be obtained. All this was illustrated by numerical examples in the paper to which reference has been made.

For the sake of completeness it should be stated that the conditions which are being discussed in the case of simple linear equations occur also in the case of simultaneous equations of any degree or character. This more general problem was encountered, discussed and illustrated in a paper on the theory of the determination of orbits which I published in the *Astronomical Journal* in 1914. In that paper it was shown by numerical illustrations that the elements of the orbits of comets are sometimes given to hundreds of seconds of arc, when other values of the elements differing from them by minutes of arc also satisfy the observations exactly.

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HYDROGEN AND CARBON DIOXIDE PHOTOASSIMILATION IN PURPLE BACTERIA

THE uptake of hydrogen together with carbon dioxide under the influence of light by suspensions of purple bacteria (van Niel)[1] was discovered by Roelofsen[2] and further investigated by Gaffron.[3] In spite of the fact that the over-all reaction is slightly exothermic we find that the process is similar to green plant photosynthesis, the quantum yield of which was measured by Warburg and Negelein,[4] in that both processes take about four quanta of light for the reduction of one carbon dioxide molecule.

Measurements of gas pressure changes were made in a mixture of 5 per cent. CO_2 in H_2 over thin suspensions of *Streptococcus varians* in 0.05 M $KHCO_3$ in tap water, irradiated with known intensities of near infra-red light of wave-length 852 with 894 mu from an Osram caesium tube. Separate measurements with the same suspensions gave the fraction of the incident light absorbed by the active photosensitizing pigment, thus allowing the calculation of quantum yields from the measured intensities and pressure changes.

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LENGTH OF LIFE OF A RABBIT

ASSUMING that the length of life of a domestic rabbit might be of interest to biologists, I submit the following case, which I think might establish a record.

The first week in December, 1926, I took a month-old brown and white female rabbit from the Biology Building, University of Wisconsin, to my home. I put the rabbit in a room in the cellar which was dimly lighted by a small window. The rabbit's activity was limited to a floor space ten by twelve feet. The rabbit ate fresh vegetables of all kinds, toast, a handful of shelled peanuts each day and drank water freely. A bale of alfalfa, which was kept in the room to supplement the above feedings, was consumed each year.

Under these conditions the rabbit lived an active life until she died in February, 1936. Death was preceded by a two weeks period of inactivity due to a stiffening of the hind legs. The span of life was ten years and three months.

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[1] C. B. van Niel, *Cold Spring Harbor Symp.*, 3: 138, 1935.

[2] P. A. Roelofsen, Thesis, Utrecht. "On Photosynthesis of the Athiorhodaceae," 1935.

[3] Hans Gaffron, *Biochem. Z.*, 275: 301, 1935.

[4] Otto Warburg and Erwin Negelein, *Z. f. Phys. Chem.*, 106: 191, 1923.

SCIENTIFIC BOOKS

PROBOSCIDEA

A Monograph of the Discovery, Evolution, Migration and Extinction of the Mastodonts and Elephants of the World. By HENRY FAIRFIELD OSBORN. American Museum Press.

THIS is the first of two volumes to cover all the Proboscidea. The survey was begun in 1909 and completed in 1935 just before the death of Professor Osborn. During this quarter of a century the knowledge of the elephant family grew with such astonishing rapidity that what appeared at the beginning a relatively simple undertaking became a maze of phylogenetic lines. From this maze of incompletely distinguished material Osborn has sorted out 41 genera and hundreds of species, grouping them in their phylogenetic relationships to make a genetic tree of the elephants almost, if not entirely, as complete as that of the horses.

Osborn was impressed by the early and repeated tendency for the elephants to adapt themselves in varied directions, so that his genetic tree is highly polyphyletic. He divides the Proboscidea into four primary phyla, coming from an unknown, pre-Eocene, African ancestor. The first of these are the small amphibious Moeritheroidea, first appearing in the Eocene of Africa, and surviving only until the early Oligocene in Asia. The second group is that of the Deinotheroidea with no upper tusks and the lower tusks curved downward. They too appear first in the Eocene in Africa, but continue to live as large animals in Europe and Asia until the Pleistocene. The Mastodontoidae is the greatest group, with no less than 27 genera. These are lowland (swamp and savanna) animals, with tusks in the upper jaw and with all sorts of modifications of the lower jaw, living from the Eocene to after the ice age, though all extinct to-day. The fourth group is that of the Elephantoidea, grazing animals, which first appeared in the Pliocene and, though represented by a few living forms, reached their supremacy in the Pleistocene. It is to this last group that the second volume is to be devoted.

The greater part of this first volume is devoted to the Mastodontoidea, which are further subdivided into several phyla. The mastodonts begin with the African Palaeomastodon in the Eocene, migrate to Eurasia, where they diverge into Miomastodon and Pliomastodon, in Europe to Turicius especially, finally reaching North America, where they prospered and lived until after the retreat of the great ice sheet.

The long-jawed mastodonts (Longirostrinae) start in Africa with Phiomia in the Eocene at or near the base of the line. In Europe and Asia the group flourished, dividing into Trilophodon with three ridges on molars 1 and 2, and Tetralophodon with four ridges on these teeth. In the Miocene the group made its way to North America and has many representatives until rather late in the Pliocene. One side line in America is Amebelodon, which developed the "shovel-toothed" character, and which Osborn feels is directly connected to Phiomia.

The Serridentinae, with medium length lower jaws and blunt ridges on the molars, have no representatives until in the Miocene in Europe. From there it spread rapidly across Asia and into North America. Beside the typical genus Serridentinus, there are several specialized subphyla, first the "shovel tuskers" of the types of Serbelodon and Trobelodon in America; second, the extremely modified "shovel tuskers" with the "rod cones," Platybelodon; and third the Pliocene mastodonts of Florida, termed Ocalientinus.

The Rhynchorostrines, with their "beaked" lower jaws turned somewhat downward, have their first representatives in the Miocene of Egypt, followed by one in the Pliocene; then they blossomed out in America as typical Rhynchotherium. In Honduras two specialized genera are given the rank of genera, Blickotherium and Aybelodon.

The Brevirostrinae, or short-jawed mastodonts, began their history in the Miocene in Europe as Anacus, then migrated to Asia, where the genera Pentalophodon and Synconolophus are separated off on account of especially long and curved upper tusks. A group which separated off from Anacus reached North America relatively early as the Stegomastodon. Here they abounded through the Pliocene and well into the Pleistocene. One genus, Eubelodon, is separated off on account of the retention of the enamel on the tusks and this, as it migrated into South America, gave rise to Cuvierenius.

The group Notorostrinae are the other South American short-jawed mastodonts of the late Pliocene. Osborn postulates that they represent two separate lines, separate back to the Oligocene, though no earlier representatives have been found. One line is represented by Notiomastodon, the other by Cordillerion.

From the foregoing it is clear that Osborn demonstrated that the elephant family is highly polyphyletic, but to the writer it seems doubtful if there were ten separate phyla as early as the Eocene or nineteen in the Oligocene. However, the monograph represents one of the greatest forward steps of recent times, and could only be done by one with unusual facilities, and

especially unusual knowledge and patience. In this volume, and the one to come, every original description and figure has been reproduced; and the tangles, into which the various species were tied by fragmentary material and inadequate comparison, have been straightened out. This will be the starting point for all future students of the elephant family.

F. B. LOOMIS

ACADEMIES AND MEETINGS

THE TENNESSEE ACADEMY OF SCIENCE

THE 1936 fall meeting of the Tennessee Academy of Science was held at Vanderbilt University on November 27 and 28. Dr. C. R. Fountain, president, presided at the general session in Furman Hall; L. R. Hesler, chairman, at the botanical session in Buttrick Hall on Friday afternoon.

Schools represented on the program were: University of Tennessee, King College, Carson-Newman College, Teachers College, in East Tennessee; Vanderbilt University, University of the South, Teachers College, George Peabody College, in Middle Tennessee; the Southwestern, Teachers College, Freed-Hardeman, in West Tennessee. Botany and biology claimed more than half of the subjects, but physics, mathematics, archeology, geography, bacteriology, engineering, were also included.

Three members of the academy, in turn, discussed the rainbow trout, the wild trilliums of the Great Smoky National Park and the availability of the park as a field for biological research.

Dr. Clinton L. Baker made a report of investigations at the Reelfoot Lake Biological Station last summer by eleven selected workers under his direction as associate director and resident biologist for the Tennessee Academy of Science. The researches are soon to be published by the academy.

The procedure and results of a research of considerable importance made by E. W. Goodpasture and Katherine Anderson were given by Dr. E. W. Goodpasture, professor of pathology in the Vanderbilt Medical School, in a paper with illustrations entitled "The Problem of Infection as Presented by Bacterial Invasion of the Chorio-allantoic Membrane of Chick Embryos."

The American Association for the Advancement of Science research scholarship for 1936 was awarded by the executive committee to Dr. Horace B. Huddle, professor of chemistry in the State Teachers College, Johnson City, Tenn.

On Friday evening there was a dinner at the Andrew Jackson Hotel, which was followed by an address, "Radio Gives the Doctor a New Weapon—ultrasonic Waves," by Dr. C. R. Fountain, president of the academy and professor of physics at George Peabody College for Teachers.

Officers were elected for the ensuing year as follows:

President, Louis J. Bircher, Nashville.
Vice-President, Peyton N. Rhodes, Memphis.
Editor, Jesse M. Shaver, Nashville.
Secretary-Treasurer, John T. McGill, Nashville.
Director of Reelfoot Lake Biological Station, Clinton L. Baker, Memphis.
Librarian, Eleanor Eggleston, Nashville.

JOHN T. MCGILL,
Secretary

THE TEXAS ACADEMY OF SCIENCE

THE annual meeting of the Texas Academy was held in the Plaza Hotel, San Antonio, Texas, on November 12, 13 and 14. The annual dinner of officers and committees was held on Thursday night, during which time an informal discussion of the business of the academy was held. This was followed by the standing committee meetings.

The general program was divided into four sections, meeting in the various assembly rooms within the hotel. The Biology Section, with E. J. Lund as chairman, listened to a number of papers ranging in subject from the experimental work done with cotton to a synopsis of the monumental paper, "The Amphibia of Texas," by A. H. and A. M. Wright, Cornell University, N. Y.

The Geology Section had a full program, with subjects ranging from the "Pleistocene Man in Texas," by M. L. Crimmins, to the first of the papers on the geomorphology of the Rio Grande Delta, by W. Armstrong Price, A. E. Anderson and John Doering.

During the noon hour the sections held independent luncheons. Outstanding among these was the geology luncheon upon the invitation of the Petroleum Club, followed by a paper on "Heaving Shales and Evidences for Their Associations with High Rock Pressures in Oil Fields," by Paul Weaver.

In the afternoon the Chemistry, Mathematics, and Physics Section had a full program with two papers on mathematics and two on physics.

The Biology Section had a program that crowded the time. The outstanding papers were those by E. P. Cheatam, Southern Methodist University, relative to his studies on mollusca; the distribution of Texas Acridians, by E. B. Isely, Trinity University; and notes concerning the vegetation of the Woodbine Sands, Denton County, Texas, by H. L. Graham, Gainesville Junior College.

The Social Sciences Section consisted of six papers, most of them having to do with the business methods of governments.

The Geology Section listened to numerous papers. Chas. N. Gould, of the National Park Service, spoke on the geology of the national parks. The discussion relative to the geomorphology of the Gulf Coast was completed.

The high point of the meeting was the annual dinner of the academy, with over two hundred and fifty present. After a most enjoyable dinner, a musical program given by the students of the Incarnate Word College, San Antonio, ushered in the regular program of the evening. Secretary Frederick A. Burt gave a review of the year's work of the academy together with the plans for the coming year and the problems that should be brought to the attention of the members. An honorary life membership was conferred upon Clyde T. Reed, the first president of the present academy. The annual address of the president, entitled "Problems of the Texas Pleistocene Ice Age," illustrated by slides, was a scholarly production. An illustrated lecture on "The Next Hundred Years" by Walter P. Taylor, senior biologist of the U. S. Biological Survey, dealt with what has happened in the last hundred years and what might be done to bring back desirable conditions that once existed.

The Saturday program found Sections on Physics, Chemistry, Mathematics and Biology in session. Chemistry predominated and centered around certain interesting organic compounds rather well known in all sciences. The Biology Section had a very full program, centered around the general topic of a marine biological laboratory to be located on the Gulf Coast. Walter P. Taylor reviewed the Texas Cooperative Wildlife Service, and connected this with what might be accomplished between the Wildlife Service and the marine laboratory. Gordon Hunter, Albert Collier and O. Sanders, all of whom have collected very largely on the Gulf, gave their reactions as to what might be done.

A business session was held during the noon hour. The officers for the following year are: Don O. Baird, Sam Houston State Teachers College, Huntsville, *president;* E. B. Isely, Trinity University, Waxahachie, *executive vice-president;* Frederick A. Burt, Texas A. and M. College, College Station, *secretary;* A. J. Kirn, Somerset, *treasurer;* Mrs. Helen Jeanne Plummer, Austin, *editor;* representative to the American Association for the Advancement of Science, S. W. Bilsing, Texas A. and M. College, College Station. A committee was appointed to select from the numerous offers made a place for the next annual meeting.

H. B. PARKS,
Secretary Emeritus

SAN ANTONIO, TEXAS

SPECIAL ARTICLES

THE SIZE OF THE UNIVERSE AND THE FUNDAMENTAL CONSTANTS OF PHYSICS[1]

THE problem of the size of the universe is usually treated in connection with the ideas of a curvature of space and an expansion of the universe. It seems, however, that results concerning the size of the universe may also be gained without any reference to these ideas. If we consider a homogeneous sphere, it follows from the theory of potentials that the amount of the gravitational energy is $3\,f\,M^2/(5\,R)$, where M and R are the total mass and the radius of the sphere and f the gravitational constant. On the other hand, the proper energy of this sphere is $M\,c^2$, where c denotes the velocity of light.

We may now make the rather obvious assumption that the amount of the gravitational energy of the sphere can not be smaller than its proper energy. This means

$$(1) \qquad \frac{3\,f\,M^2}{5\,R} \leqq M\,c^2.$$

On the other hand, the mass is equal to the density (ρ) multiplied by the volume of the sphere, or

$$(2) \qquad M = \frac{4}{3}\pi R^3 \rho.$$

The combination of the two formulas yields the relation

$$(3) \qquad M \leqq \frac{5^{3/2}\,c^3}{6\sqrt{\pi\rho}\,f^{3/2}}$$

or, if we insert the well-known values of c and f

$$(4) \qquad M \leqq \frac{10^{28}}{\sqrt{\rho}}$$

Astronomical research gave for the average mass density in the observable part of the universe the empirical value of 10^{-28} gms per ccm. According to formula (4) we find as an upper limit for the mass of a sphere of this density a value of 10^{56} gms. On the other hand, we find also an upper limit for the density of a sphere of given mass. If, *e.g.*, we assume the mass to be equal only to the sum of the masses of all actually observable astronomical objects, that is, equal

[1] A paper delivered at the Tercentenary Conference of Arts and Sciences at Harvard University, September, 1936.

to 10^{50} gms, we find as an upper limit for the density 10^{-16} gms per ccm.

It might be mentioned incidentally that we arrive at the same value for the mass of the universe as does Sir Arthur Eddington if we simply start from the following two hypotheses:

(1) That the sum of the proper energies of all particles contained in the universe equals the amount of the gravitational energy of the universe (either exactly or at least in the order of magnitude);

(2) That the sum of the spheres of action of all the electrons contained in the universe is as great as the surface of a sphere which would include a volume equal to the total volume of the universe.[2]

It might also be mentioned that Sir Arthur Eddington's wave-mechanical considerations make it probable that a purely arithmetical relation connects the masses of the hydrogen-atom and the electron, that is

$$\frac{m_H}{m} = 4\pi \times 137 \times \sqrt{\frac{17}{15}} \tag{5}$$

The ratio 17/15 is the same as 136/120, whereas the whole number 137 is, according to Sir Arthur Eddington, the reciprocal of the Sommerfeld constant of fine structure of the hydrogen-spectrum. The arithmetical relation (5) yields the value 1,833, whereas the empirical value is 1,835.[3]

The elementary quantum of action may be represented, as is well known, either as a product of energy and time or as a product of length and momentum. If we, therefore, divide the elementary quantum of action by cosmic constants of the dimensions of time, energy, length and momentum, respectively, we obtain four "subatomic" constants (about 10^{-43} ergs, 10^{-103} sec, 10^{-93} cm, and 10^{-54} gm cm sec^{-1}). The subatomic energy constant, which might be called the primordial energy-element, seems to find a simple interpretation. As is well known, the red-shift in the line-spectra of extra-galactic nebulae can be described by the formula

$$\frac{\Delta\nu}{\nu} = \frac{s}{c\,t^*} \tag{6}$$

Here $\Delta\nu$ means the diminution in frequency of a photon emitted by an object in the distance s, and $c\,t^*$ is a distance of 1,700 million light years, and therefore

$$1/t^* = 1.8 \times 10^{-17}\ \text{sec}^{-1}. \tag{7}$$

The primordial energy-element (w) is given by the relation

$$w = \frac{h}{t^*} = 1.2 \times 10^{-43}\ \text{ergs}, \tag{8}$$

h denoting the elementary quantum of action.

[2] *Cf.* A. Haas, *Phys. Rev.*, 49: 411, 1936.
[3] *Cf.* A. Haas, *Phys. Rev.*, 49: 636, 1936.

If we denote the energy of the photon by ε (where $\varepsilon = h\nu$), we may write equation (6) in the following form

$$\Delta\varepsilon = h\,\nu\,t/t^*$$

where t denotes the time during which the photon has been traveling, or

$$\Delta\varepsilon = w \times \nu \times t \tag{9}$$

We now recognize at once the significance of the constant w if we put t equal to a period of a single oscillation, that is, equal to the reciprocal of ν. In this special case the loss in energy becomes equal to w. This means that every photon, irrespective of its wave-length, gives off a primordial energy-element during each vibration or in traveling one wave-length.

The number of primordial energy elements which are given off in a definite time depends on the frequency, but the relative diminution in energy in this time is independent of the frequency. A violet photon, *e.g.*, loses twice as many primordial energy elements per second as a red photon, but, on the other hand, the violet photon contains twice as much energy as the red photon.

We have in the universe, on the average, a quantity of radiant energy of about 3×10^{15} ergs, referred to one gram of matter.[4] The loss in radiant energy which is the consequence of the continual "reddening" would, therefore be, according to equation (6)

$$3 \times 10^{15} \times 1.8 \times 10^{-17}$$

or about 0.1 ergs per gram and second.

On the other hand, the energy production by the stars and star-systems amounts to about one tenth of an erg per gram and second.[5] The energy which is given off in the form of primordial energy elements might, therefore, be compensated by the energy production of the stars. Perhaps we might consider the energy which is liberated in the form of primordial energy elements, as the source of the radiation of the star-systems.

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TYPE SPECIFIC ANTIPNEUMOCOCCUS RABBIT SERUM

BOTH horses and rabbits may be immunized against pneumococci of the various types, and the sera of these animals not only react specifically *in vitro* with the homologous micro-organisms and their products, but also afford protection against infection in laboratory animals. The sera from these two species of animals,

[4] *Cf.* A. Haas, "Kosmologische Probleme der Physik," Leipzig, 1934, Chapter IV.
[5] *Cf.* A. Haas, *Anzeiger Akad. Wiss. Vienna*, 70: 265, 1933.

however, differ in a number of properties. The antibodies of the two species differ in size, solubility and degree of specificity.[1,2] The optimum physical conditions for the interaction between antigen and antibody are different for sera of the two species and the immune precipitates formed with the polysaccharides are distinctive in appearance. Evidence has been presented indicating that the antibody in horse serum is a lecithoprotein, while that in immune rabbit serum is a cephaloprotein.[2] Indeed, sera from the two species have been found to differ in their immunological properties in at least thirty respects.

Some of these differences suggest that antipneumococcus rabbit serum may possess certain advantages over horse serum in the treatment of lobar pneumonia.

(1) Immune rabbit sera confer a greater degree of protection on mice in proportion to the content of specifically precipitable protein than do antipneumococcus horse sera, as is shown in Table I. This is probably related to the fact that the antibodies in immune rabbit serum are of smaller size than are those in horse serum. The latter fact also suggests that diffusion of the immune substance into infected foci may occur with greater readiness in the case of rabbit serum than with horse serum.

TABLE I

MOUSE PROTECTIVE POTENCY WITH REFERENCE TO AMOUNT OF SPECIFICALLY PRECIPITABLE NITROGEN

Serum	Mouse protective units per cc	Maximal amount of specifically precipitable nitrogen	Protective units per mg specifically precipitable nitrogen
Horse A concentrated..	3,000	5.80 mg	520
Horse B unconcentrated	750	1.51 "	500
Rabbit A unconcentrated	1,700	1.51 "	1,120
Rabbit B unconcentrated	1,400	0.67 "	2,090

Protective units of sera determined by method of Kirkbride, Hendry and Murdick.[3] Specifically precipitable nitrogen determined by the method of Heidelberger and Kendall.[4]

(2) In mice, small amounts of cholesterol, cephalin or materials rich in these lipids block the protective action of antipneumococcus horse serum but are without effect in the case of rabbit serum.[5]

(3) In massive infections in laboratory animals there are optimal amounts of antipneumococcus horse sera which must be used in order to obtain successful results. Larger amounts are less efficacious and still larger amounts may have no protective action whatever. This "prozone" effect is not observed with antipneumococcus rabbit serum.[6]

(4) Although it is still a moot question as to whether complement may be involved in the protective action of immune serum against pneumococcus infection in animals, it may be pointed out that *in vitro* complement fixation does not occur when pneumococcus polysaccharides are mixed with immune horse serum, while it does take place when they are mixed with immune rabbit serum.[7]

(5) As compared with horses, rabbits almost invariably respond to pneumococcus immunization with the production of serum of good titer. If serum treatment is to be carried out in all cases due to any one of the thirty or more types, the production of these sera would be greatly simplified by employing small animals rather than horses.

(6) In our hands the cost of producing immune rabbit serum is definitely less than the cost of producing concentrated antipneumococcus horse serum. The increased cost of handling small animals is more than offset by the fact that concentration of rabbit serum is less necessary in view of its high potency.

(7) Owing to the present wide-spread use of immune horse serum in a variety of conditions, the number of individuals artificially sensitized to rabbit serum is probably much less than the number of persons sensitized to horse serum and the danger of anaphylactic reactions may therefore be less if rabbit rather than horse serum be employed in treatment.

In view of these considerations and the fact that there appeared to be no contraindications to its use, antipneumococcus rabbit serum was first employed in this hospital in the treatment of Type I lobar pneumonia in man in April, 1936. Subsequently similar preparations have been used in the treatment of cases due to pneumococci of certain of the other types as well.

The series of cases in which rabbit serum has been used is as yet not sufficiently extensive to permit conclusions to be drawn concerning its efficacy as compared with horse serum, and the clinical results obtained will form the subject of a subsequent communication. In Type I pneumonia, however, in which a large experience in treatment with horse serum has already been gained in this hospital, treatment with immune rabbit serum in the few cases in which it has been employed has apparently been very efficacious. The experience so far obtained indicates that rabbit

[1] K. Goodner, F. L. Horsfall, Jr., and J. H. Bauer, *Proc. Soc. Exp. Biol. and Med.*, 34: 617, 1936.

[2] F. L. Horsfall, Jr., and K. Goodner, *Jour. Exp. Med.*, 62: 485, 1935.

[3] M. B. Kirkbride, J. L. Hendry and P. P. Murdick, *Amer. Jour. Hygiene*, 23: 187, 1936.

[4] M. Heidelberger and F. E. Kendall, *Jour. Exp. Med.*, 61: 559, 1935.

[5] K. Goodner and F. L. Horsfall, Jr., *Jour. Exp. Med.*, 64: 377, 1936.

[6] Goodner, K. and F. L. Horsfall, Jr., *Jour. Exp. Med.*, 62: 359, 1935; and 64: 369, 1936.

[7] H. Zinsser and J. T. Parker, *Jour. Immunol.*, 8: 151, 1923.

serum is no more toxic for man than is horse serum; immediate reactions do not occur with any greater frequency. Serum sickness has been infrequent and of a mild character.

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IDENTICAL TWINS IN A MOUSE CROSS

IN 1934 the late Dr. C. V. Green[1] published statistical evidence that there occur occasionally in mice uniovular twins, since pairs of individuals with identical color characters and of like sex occur more frequently than chance alone would indicate to be probable. Miss Bodemann[2] has also described and figured two mouse embryos in the primitive streak stage found enclosed within a common yolk sac endoderm layer, among the progeny of x-rayed mice, evidence which points to the same conclusion as that reached by Green.

We are able to support Green's conclusion with observational evidence of the occurrence of a pair of identical twins under conditions which render their identification all but unmistakable.

The genes for two recessive mutant characters (dilution (d) and short ear (se)) are borne in the same mouse autosome at closely adjacent loci. Gates (1928), who made a "repulsion" cross, observed no crossovers in an F_2 population of 426 individuals involving a test of 852 chromosomes. Snell (1928), however, in a similar but more extensive search for cross-overs reported the occurrence of one crossover in 1,158 cases; later in data hitherto unpublished he observed two crossovers in 890 cases. In backcross populations, Miss Copeland in 1931 reported the occurrence of one crossover in 106 cases, an observation confirmed by Snell, though he himself observed no crossovers among 1,034 backcross young. Combining these various observations, the indicated occurrence of crossovers up to 1931 was 4 in 4,040, or roughly 1 in 1,000 cases.

Subsequently, Castle, Gates, Reed and Law[3] made a cross in which short ear and dilution were introduced in the coupling relationship, reciprocal backcrosses being later made to the double recessive (d se) race. The observed recombinations and their respective frequencies were as follows:

	D Se	d Se	D se	d se
♀ F_1 × ♂ d se	827	2	0	792
♂ F_1 × ♀ d se	67	0	1	68
Totals	894	2	1	860

Three crossovers were thus observed in 1,757 cases, or about 1.75 to a thousand, a frequency somewhat greater than that previously reported, but based chiefly on the behavior of heterozygous females in which crossing over is known to be more frequent than in males. We may then safely conclude that the normal amount of crossing over between the loci for dilution and short ear is not over one or two for a thousand cases.

Besides the three crossover cases already reported, there was observed, in a backcross between a doubly heterozygous female and a double recessive male, a pair of dilute brown males having long ears and so belonging in the crossover class, d Se. Since a crossover has a probability of occurrence of only one or two in a thousand, the odds against the occurrence simultaneously in the same litter of two independent crossovers identical in sex and three independent color characters would be about 332 to 1, according to calculations made by Snell, the details of which need not be reported here.

We accordingly regard the conclusion as justified that the pair of long-eared dilute brown male individuals which occurred in the same backcross litter were in reality *identical twins* derived from the fertilization of a single egg in which a rare crossover had occurred between the loci for dilution and short ear.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A NEW APPARATUS FOR CONSTANT TEMPERATURE

THE continuous maintenance of precise temperatures by the use of heating units is now a relatively simple matter, but the available temperatures dependent upon the controlled application of heat are necessarily above the temperature of the room in which the apparatus is kept. There is also equipment for maintaining fixed temperatures below room temperature by the use of refrigerating units. In connection with experimental work by the senior author, it was desired to have several chambers in which constant temperature could be maintained independently of room temperature, the temperature of one chamber would be independent of that of any other, and there would be complete flexibility within a wide range of low and high temperatures.

We have designed and had in satisfactory use for

[1] SCIENCE, 80: 616, December 28, 1934.
[2] *Anat. Record*, 62: 291–294, 1935.
[3] *Genetics*, 21: 310–323, July, 1936.

nearly two years a relatively inexpensive multiple constant temperature apparatus meeting these requirements. It contains a single refrigeration chamber from which a non-freezing fluid circulates through the other chambers, each of which is provided with a simple heating unit (an incandescent light bulb in our case) controlled by an accurate thermoregulator. The flow of cold fluid need be regulated only roughly. For temperatures above the possible high level of room temperature, the flow of cold fluid is of course stopped.

We have not as yet tried to maintain temperature above 50° C. or more than slightly below freezing, but these extremes in our own practice do not necessarily mark the limits to which the apparatus is adaptable. Similarly, although we have now only six culture chambers, there is no apparent reason why the number of chambers may not be increased.

The setting of the temperature in any chamber to a tenth of a degree requires but a few minutes or perhaps a half hour, depending upon one's skill in manipulating the thermoregulator. Thereafter the temperature of the chamber remains constant for weeks or months, unless a change is desired or an accident intervenes, and, with ordinary care, the latter contingency need rarely, if ever, arise. Because of the heavy insulation, even the cessation of electric currents for a short time effects little change; the circulation of cooling fluid, as well as the operation of the heating unit, is arrested with interruption of electric current.

This multiple-chambered constant temperature apparatus is described and illustrated in a forthcoming issue of the *Journal* of the Elisha Mitchell Scientific Society.

R. E. COKER
E. W. CONSTABLE

UNIVERSITY OF
NORTH CAROLINA

THE VISUALIZATION OF DIFFERENT ORGANS IN NORMAL UNANESTHETIZED ANIMALS

EXPERIMENTS have recently been performed in which the colons of cats were made permanently opaque to x-rays by injecting a solution of thorium dioxide (Thorotrast) just underneath the serous membrane at various points along the entire length of the colon wall. Three to four weeks after the operation this material became quite uniformly distributed, so that it gave a clear outline of the organ which could be studied in an empty as well as a distended state.

The animals showed no harmful effects from the presence of the Thorotrast. One cat, whose colon was injected over sixteen months ago, and three others more than seven months ago are still in apparently perfect health.

Experiments to visualize the stomach and urinary bladder of cats as well as the crop, gizzard and uterus of the fowl in the same manner are now under way which promise to give results just as satisfactory as those obtained on the colon.[1]

F. R. STEGGERDA
UNIVERSITY OF ILLINOIS

C. GIANTURCO
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A METHOD OF DEMONSTRATING CO_2 PRODUCTION DURING RESPIRATION

BARIUM hydroxide and the formation of barium carbonate have been much used in elementary botany classes to demonstrate the production of CO_2 by germinating seeds during respiration. The writer has made use of a method which is even more striking and which requires no special apparatus. Two 250 cc Erlenmeyer flasks are connected in series by the usual method, *i.e.*, right angle glass tubing, rubber tubing and single hole cork stoppers. In flask A are placed 100 pea seeds which have been germinated from 12 to 24 hours. In flask B are placed 50 cc of an alcoholic solution of phenolphthalein, to which has been added a drop of 10 per cent. NaOH, just sufficient to give the solution a brilliant red color. Before the apparatus is connected the students are shown the characteristic color reaction of phenolphthalein in acid and basic solutions. The connection is then made between flasks A and B and in a few days it will be noted that the phenolphthalein solution has lost its color. This demonstration has been found to be of interest to students in the class in elementary plant physiology at Vanderbilt University and might easily be used to supplement the usual demonstration in the general course.

SAMUEL LEWIS MEYER
MILLER SCHOOL OF BIOLOGY
THE UNIVERSITY OF VIRGINIA

[1] A more complete description of this method will appear in the *Anatomical Record* of 1937.

BOOKS RECEIVED

ALLISTON, NORMAN. *Mathematical Snack Bar; A Collection of Notes and Results.* Pp. 155. Heffer, Cambridge, England. 7s. 6d.

Collection de Monographies sur la Théorie des Fonctions. *Théorie Générale des Fonctionnelles.* Tome I: *Généralités sur les Fonctionnelles, Théorie des Équations Intégrales.* Vito Volterra et Joseph Pérès. Pp. xii + 359. Gauthier-Villars, Paris. 100 fr.

DE DONDER, TH. and PIERRE VAN RYSSELBERGHE. *Thermodynamic Theory of Affinity; A Book of Principles.* Pp. 142. 4 figures. Stanford University Press. $3.00.

Transactions of the Royal Entomological Society of London. Vol. 84, *The Tsetse Flies of East Africa; A First Study of their Ecology, with a View to their Control.* C. F. M. SWYNNERTON. Pp. xxxvi + 579. 33 figures. 22 plates. The Society, London.

The Journal of Experimental Zoology

Published by The Wistar Institute

Ross G. Harrison, Managing Editor, Yale University

Vol. 74 *Contents for August, 1936* **No. 1**

TH. DOBZHANSKY. The persistence of the chromosome pattern in successive cell divisions in Drosophila pseudoobscura. Eighteen text figures.

N. J. BERRILL and D. MEES. Reorganization and regeneration in Sabella. II. The influence of temperature. III. The influence of light. Four text figures.

J. M. ODIORNE. The degeneration of melanophores in Fundulus. Five text figures and five plates.

G. SNIDER and H. KERSTEN. Susceptibility to soft x-rays of Daphnia magna during its development from egg to young in the brood pouch. Three text figures.

A. COHEN and N. J. BERRILL. The development of isolated blastomeres of the ascidian egg. Four text figures.

M. H. HARNLY and M. L. HARNLY. The effects of the gene on growth and differentiation as shown by the temperature responses of pennant and its heterozygote in D. melanogaster. Four text figures.

D. C. WARREN and H. M. SCOTT. Influence of light on ovulation in the fowl.

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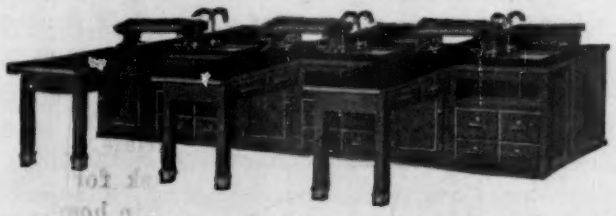

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SCIENCE NEWS

Science Service, Washington, D. C.

THE GRASSHOPPER MENACE

GRASSHOPPERS, plus failure to act on the part of Western state governments, have confronted the wheat-growing region beyond the Missouri with a very serious threat, added to the already existing crop shortage due to the drought.

Last fall, the Bureau of Entomology and Plant Quarantine of the U. S. Department of Agriculture, found unusually large numbers of grasshopper eggs in the soil of the plains and western prairies. At that time the various state governments concerned were warned so that stores of poison bait might be ready when the insects should hatch and begin crawling, this spring. Without exception, the state governments did nothing.

Now the grasshoppers have developed almost to the point where they have wings and begin flying in hordes. The Western states, alarmed, asked the Congress for aid, since their legislatures had adjourned and there was no way of providing funds to meet the emergency which their inaction had permitted to arise. In its closing hours, the Congress pushed through a joint resolution transferring a quarter of a million dollars from a chinch-bug war fund not immediately needed. This is now at the White House, awaiting President Roosevelt's signature.

Agents of the Bureau of Entomology and Plant Quarantine in the West are locating the necessary raw materials for the poison bait: arsenic compounds or sodium fluosilicate, molasses and trainload lots of bran. They are also making preliminary arrangements for transportation to the 'hopper-infested areas. So as soon as the joint resolution is signed the battle front can be built against the grasshoppers.

Even with the speediest possible action, there is considerable doubt whether disaster can be averted this year. Only a few days remain in which a poison-bait campaign can be expected to have any effect at all. Unless the materials are bought, distributed, mixed and placed where the crawling young of the grasshoppers can find and eat the poison bait before the Fourth of July, it will be too late.

Furthermore, the sum made available is estimated to be only about a third of what would be needed for a really effective fight against the 'hoppers. The Bureau of Entomology and Plant Quarantine was not consulted either as to the desirability of using federal funds for this purpose or regarding the adequacy of the amount or the timeliness of action. They are rather in the position of Gallieni's "taxicab" army before Paris in 1914: hastily mobilized, insufficiently munitioned, yet expected to stem the oncoming hordes in gray.

RARE METALS IN METEORITES

DISCOVERY of notable amounts of the rare metals, gallium and germanium, in the earth's only imports from outer space, the meteorites that fall from the sky, was announced by Dr. Arthur S. King, of the Carnegie Institution's Mount Wilson Observatory, in a paper presented to the Society for Research on Meteorites meeting at Los Angeles on June 25.

Emphasizing the usefulness of spectroscopic analysis instead of the regular chemical and mineralogical methods for determining the elements present, Dr. King found that iron meteorites have some 19 elements within them, including in largest quantities iron, nickel, cobalt and copper.

In spectroscopic analysis, the different kinds, colors, wave-lengths or spectral lines of light are viewed or photographed and studied. Each element when heated intensely flies its own kind of light "flag" and the intensity of the spectral line is greater the larger the amount of the element present.

The rare metals gallium and germanium in meteorite samples produce very distinct spectrum lines, Dr. King explained. While they are widely distributed in earthly rocks, they occur in very small quantities.

Unlike irons of the earth, iron meteorites are almost free from chromium and manganese. Another interesting fact is that traces of silver are present and those from Meteor Crater in Arizona give the silver spectrum in considerable strength.

Stony meteorites also are found and they are quite different in composition from the iron ones although they contain a large percentage of iron. Dr. King suggests that the iron explains why the stony ones are not entirely consumed by heat when they smash into the earth's atmosphere.

A large amount of sodium is a striking feature of stony meteorites as analyzed by the spectroscope. There is nearly as much magnesium in them, and Dr. King suggests that the high content of this metal that burns with a bright flame accounts in large measure for the spectacular features of meteoric falls that are seen over large areas when they occur.

THE USE OF X-RAYS IN TESTING MATERIALS

LOOKING inside all sorts of materials, from concrete to tobacco, is becoming a common task for x-rays, usually considered a tool for use of doctors in hospitals.

Foundries and welding shops use x-rays as a routine for control and inspection of the metal they produce. Earnshaw Cook, of the American Brake Shoe and Foundry Company, Mahwah, N. J., reported to the American Society for Testing Materials at Atlantic City on June 27 that "the installation of x-ray laboratories in commercial jobbing foundries is an economic measure, inherently profitable to the manufacturer and a reliable assurance of improved and maintained quality to the trade."

X-rays allow the detection of holes, cracks, inclusions and other defects in metal. With the growth of welding, x-ray equipments have multiplied for use in inspection of joints and other products made by welding.

J. C. Hodge, of Babcock and Wilcox Company, Barber-

ton, Ohio, reported that in building the giant hydraulic power penstocks of Boulder Dam, 270,000 feet of x-ray films were used for the examination of their welded joints.

Herman E. Seemann, of the Eastman Kodak Company, reported that x-rays have solved problems in connection with ceramics, concrete, mica, coal, asbestos, foods, tobacco, plastics, textiles, paper, leather, wood and other materials.

Radioactive substances, such as radium, giving off gamma radiation similar to but more powerful than x-rays, are also being used for non-destructive testing of materials, and Norman L. Mochel, Westinghouse engineer, predicted greater utilization of radium in materials testing, particularly where portability is an advantage.

HEREDITY OF CANCER

TAKING issue with Dr. Maude Slye, of the University of Chicago, Dr. Clarence Cook Little publishes his most recent findings on heredity and cancer in the *Journal* of the American Medical Association for June 27. Dr. Little, whose research, also with mice, has been done at the Roscoe B. Jackson Memorial Laboratory, Bar Harbor, Me., contends that he has disproved Dr. Slye's hypothesis that the incidence of all spontaneous cancer is due to a single Mendelian recessive hereditary factor.

There have recently come to maturity in Dr. Little's laboratory female mice that are first generation hybrids between cancer and "non-cancer" strains. A large number of cases of cancer have been developed among these first generation hybrids. The amount of cancer of the breast appearing among virgin female mice of the first hybrid generation is largely dependent on the strain from which the female ancestor is derived. If a "high" strain female is crossed with a "low" strain male the incidence of breast cancer in the virgin female hybrids is approximately 39 per cent. On the other hand, when a "low" strain female is crossed with a "high" strain male the incidence of cancer of the breast is only 6 per cent. This difference holds good for the second hybrid generation.

Dr. Little states that this type of inheritance is non-Mendelian. It follows the maternal line and definitely establishes the existence of genetic influences outside the chromosomes. He states that "The accepted method of making human matings militates against the practical use of controlled heredity as a means of reducing the incidence of cancer in man. This, however, does not prevent the genetic approach to the problem in the laboratory and the use of controlled homogeneous inbred strains of mice from being extremely favorable material for pure scientific research in the nature and cause of cancer."

Dr. Little is managing director and editor of the American Society for the Control of Cancer.

ITEMS

CANADA'S plague of forest tent caterpillars, which have been stopping trains in Ontario, are not expected to raise trouble in the United States this season, according to Dr. F. C. Craighead, of the Bureau of Entomology. The species reaches its climax in late May and early June, after which the caterpillars "go to sleep" as pupae, to emerge in late summer as moths and lay their eggs. Northern Minnesota resorts have suffered somewhat from the crawling pests this spring. They made life miserable for early vacationists, and ate all the leaves off the poplar trees. However, the leaves will grow again, so that the resorts will be in normal condition for the regular summer business.

DOWNY mildew or blue mould, a destructive disease of tobacco plants which has been retarding the growth of the Australian tobacco industry, is likely to be conquered as a result of the research of Dr. H. R. Angell, J. M. Allan and A. V. Hill, of the Council for Scientific and Industrial Research, Canberra, Australia. It was found that the infection of the tobacco plants was in the seedling stage and the practice was adopted of growing the seedlings in special beds which could be covered with glass and in which they placed a number of shallow vessels containing benzol or toluol, chemicals which are hostile to fungus growth. The young seedlings, therefore, grew in an atmosphere containing the vapor of one or other of these substances and though they remained strong and healthy themselves the fungus causing the disease got no opportunity to grow. Once the young seedlings had survived the critical stage they could be transplanted without fear of further infection.

DR. LEO SCHWARTZ, in the current issue of *Preventive Medicine*, states that persistent hoarseness calls for careful examination by a trained throat specialist. He calls hoarseness the "herald symptom" of cancer of the larynx and points out that it is also the symptom of forty-nine other conditions, none of them trivial. Cancer of the larynx gives its warning sign earlier and remains localized longer than cancer anywhere else in the body, and early diagnosis and treatment offer a better chance for recovery than in other cancers. In the early stage this condition can be relieved by an operation which does not deprive the patient of his voice or necessitate the use of an artificial voice box.

PROBABLY the first two reports ever published of direct observations and measurements of pressure in the common bile duct of man are contained in the current issue of the *Journal* of the American Medical Association. Dr. Harold A. Kipp, of Pittsburgh, operated on a man, seventy-eight years old, and formed a communication between the gall bladder and the stomach. With a manometer he measured the variations in bile pressure in inches of normal salt solution, and found that laughing, coughing and even standing up influenced the flow of bile in the patient. Three physicians from Rochester, Minn. —Dr. John M. McGowan and Dr. Winfield L. Butsch, of the Mayo Foundation, and Dr. Waltman Walters, surgeon —with the cooperation of their patients showed that there is an increase in the pressure within the common bile duct after the gall bladder has been surgically removed.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE DROUGHT

DROUGHT is doubly cruel to grain farmers and stockmen of Midwest and Northwest, because this year began with fair promises of returning abundance. During the past few years, dry fields had to be seeded in a spirit of grim chance-taking. But this spring it was different. The earth was moist at planting-time, and everything looked good. The young wheat sprouted bravely and the hopes of the farmers went up with the green blades.

But even while the wheat grew so hopefully, betrayal was at hand. From the first of March onward, the rains began to fail. At first the shortage was not severe; spring wheat was sown, and winter wheat took its fresh start, from the reserves of moisture in the soil. But the showers became ever fewer and scantier, and presently the reserve moisture in the soil, laid by for rainless days, was all gone. The crop was bankrupt. And Harry Hopkins had to buy a ticket to St. Paul, to face anew the menace of want on the front of the Northwest.

The promise of the early year was so fair that it is hard to believe in the reality of the disaster that has been brought to a sudden head by a few weeks of furnace-hot weather. After the terrible drought of 1934 ended, with sweeping rains in September of that year, precipitation continued nearly normal or even above normal for the whole afflicted wheat region, excepting only the blighted Dust Bowl at the southern end of the Great Plains.

The winter of 1935 especially set out to be helpful. True, it was very cold and full of howling blizzards, but by the same token it brought plenty of snow. The northern Great Plains had a better snow cover than they had had for years. A summary study by the U. S. Weather Bureau showed that the period of nearly-normal to supernormal moisture in the Northwest lasted for eighteen months; from September of 1934 until the late winter of 1936. Then the snow thawed, the farmers eagerly worked the unwontedly moist soil—and the drought began to creep up on them, betraying their optimism again.

The situation in the Northwestern wheat country is the really terrible thing, though it may presently find itself competing for front-page notice with a second center of drought that has been developing along with it, centering over Kentucky and covering the rest of the middle Ohio basin. The Southeast, robbed of its market vegetable crop by an early drought, has been relieved by recent rains, so that things now look more hopeful for the later crops—cotton, grain and pastures. The one-time Dust Bowl, converted into a Mud Bowl by torrential rains some weeks ago, is out of the drought picture for the present—though it may come back into it again.

The country's greatest single crop, corn, is not as yet in such severe danger, at least in the parts of the Corn Belt that were covered with last winter's mountainous snowbanks. Those banks of snow held more wealth than many pretentious banks of brick in the towns, for they replenished the depleted subsoil moisture and got the crop off to a very good start, though somewhat belated. The drought has been over the Corn Belt, too; but corn is a deep-rooted crop, and now has its feeders well down into the ground. So unless the heat becomes even worse than that of the purgatorial summer of 1934, the corn will come through.

DROUGHT AND ENGINEERING

WE are commonly prone to think of drought as a matter between the weather man on one side and the farmer and stockman on the other. It is their worry, primarily: let the scientist warn the food producers, and let the latter take what steps they can to protect themselves. That is just about how it looks to most of us, most of the time.

Yet engineering most decidedly is in the picture. The point is, that engineering has been there so long that we calmly accept it as a part of the natural landscape, and not as something man has done.

But if we consciously look at the situation, and compare it with what it was in pioneer days, before transit and level, pick and shovel and sledgehammer, then we may "come to" with something of a start. We read now that railroads stand ready to transport feedless, waterless stock to regions of more abundance, there to be kept alive until the drought breaks and they can go back home.

But in the early stockraising days, before railroads were as highly developed as they are now, and long before improved highways and big motor-trucks, stock had to go out of a drought-afflicted country under its own hoofed motor power, even as it had when Jacob's sons heard that there was grain in Egypt and so went down from the parched land of Canaan.

Such an exodus was always attended by terrible losses, both in animals that died outright, and in wasting away even of the survivors through the hardships of a forced march with little feed and almost no water. Engineering does not prevent droughts, but it has succeeded in mitigating their consequences very materially.

Engineering "in the little" also has its benefits and possibilities. One of the unremitting efforts of both federal and state agricultural engineers, in all the West, has been to teach men how to build dams, so that at least a piece of the creek might remain on the farm, to keep the stock alive after the rest of the water has all run by. It may be expected that the present drought, like its predecessors, will spread this gospel mightily among such as are still unconverted.

And incidentally, these dams will not merely save water, they will help to save the land, too, from the gnawing curse of soil erosion.

A NEW STEEL MILL

BY WATSON DAVIS,

Director of Science Service

MAN and machine reach new heights of coordination in a steel strip mill, such as was exhibited at Lackawanna,

N. Y., near Buffalo, to a group of newspapermen by the Bethlehem Steel Company. Human brains and skill, both in design and operation, combine with precise and delicate control of large electrical power to roll in a few minutes a thick slab into a lengthy strip of steel sheet metal.

To see a red-hot chunk of steel pass successively through eleven huge sets of rollers, that squeeze it thinner, wider and much longer, is one of the best spectacles of modern industry. Clouds of steam arise from the cooling water sprays on the rolls, electric switches click, and the long radiant carpet of metal rushes down a path of smooth-running rollers to be coiled automatically like so much adding machine tape. Two and a half tons of steel ribbon, not touched by human hand or brawn, the creation of human brains and skill.

Behind this rapid metamorphosis of crude steel into sheets for automobiles, refrigerators, furniture, and a hundred other products, is precise electrical control. The modern rolling mill would be impossible without the flexibility and responsiveness of motors, thousands of them, mounted upon the machines. In a lofty central room, "pulpit" to steel men, where he may survey the whirling mill below, is the god of the machine, the operator, playing with skillful mind and fingers on the bank of the switches that are masters of the wheels below. In a vast electrical room, giant moto-generator sets whir, giving the direct current that drives the machines.

As much power is used by a strip mill as by a large ocean liner, some 35,000 horsepower for the new Bethlehem mill. Without the development of electrical power devices, particularly the direct current motor precisely controlled by resistance changes, such modern strip and sheet mills would not be possible.

Do not imagine that the human element is entirely lacking. Automatic as the machine appears in its smooth operation, yet constant manual adjustment is necessary in order that the strip may flow out smoothly. Essential is the proper relative motion of the squeezing rolls, speeding up as the rolling proceeds, and this fine adjustment is made by the human operator, second by second. And man had to make the machine.

Months and years of engineering experience were necessary to produce the American-developed continuous strip-sheet mill, of which there are now about twenty, besides the new one that arose in less than a year on waste land in Lackawanna.

The brawn of strong young arms is still necessary in the game of steel, but gone are the backbreaking, roasting tasks that Charles M. Schwab, veteran steel man, reminisced about when he saw the Lackawanna mill for the first time. Labor per ton of steel produced has been vastly reduced, yet leaders like E. G. Grace, president of the Bethlehem Steel Company, remind that more men than ever are employed in making steel. More steel per man employed, they argue, when it goes out into industry, creates more jobs. It will, to be sure, if purchasing power allows the public to gratify yens for more things of steel.

This recurring adjustment of man to new machines is one of the most troublesome situations confronting modern life. The machines are marvellously built and controlled. Better engineering of the human element is another and less solved problem.

ADVANCES IN CANCER RESEARCH

THREE significant advances in the fight against cancer appear in the last issue of *The American Journal of Cancer*.

A difference between the blood plasma in healthy persons and in patients suffering from cancer can be detected by the use of an instrument of modern physics, the spectrograph, is reported by Alexander J. Allen, Rachel G. Franklin and Edward B. Sanigar, of the Biochemical Research Foundation of the Franklin Institute, Philadelphia. Similar differences were found by this method in blood plasma from cancerous and normal animals. The difference is considered due to an increase in the fibrinogen-globulin content in the blood in cancer.

Occurrence of both cancer and leukemia in mice following injection of the cancer-causing coal tar compound, water-soluble 1:2:5:6-dibenzanthracene, was reported by Drs. Harold Burrows and J. W. Cook, of the London Free Cancer Hospital. Occurrence of leukemia is the interesting feature, since this fatal disease characterized by greatly increased numbers of white blood cells is thought to be similar to cancer. The experiments were preliminary ones designed to determine the cancer-causing potency of a new dibenzanthracene compound. Consequently it is believed to be too early to state that this compound caused the leukemia, though this seems possible.

Further information on the rôle of hormones in the causation of cancer was obtained in studies by Drs. V. Suntzeff, E. L. Burns, Marian Moskop and Leo Loeb, of Washington University School of Medicine, St. Louis. Long continued injections of the female sex hormone, estrin, increases the incidence of breast cancer in mice, these investigators found. The effect varies directly with the size of the dose and the hereditary tendency of a given strain to cancer. Cancer of the mammary glands was produced "at least as readily" by injections of female sex hormone in male mice of high tumor strains as in non-breeding females of the same strain. This shows that the mammary gland or breast of male mice is hereditary at least as predisposed to the development of cancer as the female gland.

HEALTH IN THE CCC CAMPS

LIFE in CCC camps proved much safer than life in the surrounding communities when an epidemic of menigococcic meningitis occurred in Missouri and Kansas last summer.

Now it can be told to doctors and the public, and in the forthcoming issue of *The Journal of the American Medical Association* Captain Dwight M. Kuhns, of the Army Medical Corps, Fort Leavenworth, Kans., reports on the control measures adopted in three CCC camps when the disease broke out.

The CCC boys, in addition to the usual quarantine,

daily medical examinations and inspection and sterilization of food and dishes, were treated early witn anti-meningococcus serum. Only one boy died, a mortality rate of 11 per cent. Outside the CCC camp, 83 per cent. of the patients died.

Aside from the serum used, the most effective control measure at the camps was to do away with all crowding. A space of three feet between cots was required, and head to foot sleeping was initiated.

In the end 395 persons were given meningococcus filtrate to determine its value as a skin testing and immunizing substance. None in the intervening ten months has developed meningitis, although at Tarkio, Mo., scene of the first outbreak, four cases developed among those not immunized.

In presenting this preliminary report, Captain Kuhns states that in order to prove the value of the meningococcus filtrate as a skin testing and immunizing agent it should be used in a large number of epidemics over a long period of time.

JAPANESE EARTHQUAKES

FOUR thousand earthquakes a year! This is the average number of perceptible ones for all Japan. It is small wonder that this country has proved a fruitful laboratory for seismologists.

Recently the Earthquake Research Institute of the Imperial University of Tokyo, Japan, held an exhibition of instruments, apparatus, maps, diagrams, statistics, etc., commemorating the tenth year since the establishment of the institute and the fifty-fifth year since the organized study of seismology began in Japan.

In 1880, the Seismological Society of Japan was organized by American, English and Japanese scholars in Yokohama and Tokyo for the study of conditions preceding, accompanying and following earthquakes. One of them, Sir James Alfred Ewing, later a principal of Edinburgh University, invented a horizontal pendulum seismograph in cooperation with Thomas Gray, who added a heavy bob suspended by a spiral spring with which to record vertical motion. The instrument which they worked out has been the model for seismographs throughout the world ever since.

Dr. Mishio Ishimoto, director of the institute, is the inventor of a number of instruments to aid in the study of earthquakes, chief among them being the tiltgraph and the accelerograph. With the tiltgraph, which has now been in use for eight years, it has been possible to prove the truth of the proposition of T. Terada, C. Tsuboi and N. Miyabe, that the crust of the earth (at least in Japan) is composed of blocks. These blocks appear to be several miles in diameter; a general upheaval of the ground is produced by the combined motion of the blocks.

As for the cause of an earthquake, while some hold that it originates from a pair of sliding "faults," or deep crustal cracks, the findings of the Japanese scholars indicate, rather, a movement of the magma, or plastic matter, under the crust of the earth. Mr. Tanahashi, of the Kobe Marine Meteorological Observatory, who is interested in the motions which initiate earthquakes, in the pushing waves and the pulling waves, has made a study of the distribution of initial motions; and he finds that a quake may start from several points at the same time, as, for example, in the deep-seated earthquake of June 2, 1931, when the source of motion was quadruple.

Inasmuch as Japan is traversed by six earthquake zones and has in the past 340 years suffered from 27 major earthquakes which took the lives of 161,822 people, it is to be expected that this country should be particularly interested in earthquake prediction. But, although statistics have proved the correlation between quakes and barometric pressure, its gradient, precipitation, tides, etc., these are only the trigger; and as the late Dr. Suyehiro remarked, "An unloaded gun can not be fired by pulling the trigger." Part of the task ahead is to learn when the gun is loaded, and with what.

ITEMS

WITH a new and second outer shell expanding and rushing outward at the record rate of 2,100 miles per second, the "new" star or nova now visible in the sky is unusually interesting to astronomers of Mount Wilson Observatory of the Carnegie Institution, at Pasadena. A gigantic outrush of gases in the form of a shell is usual with such novae, but two days after its discovery on June 18 Nova Cephei (or Nova Lacertae as it is also called, since it is on the border of the two stellar constellations) developed a second outburst which achieved the largest velocity thus far measured in any nova. Now dimmer than it was at the peak of its outburst, the star at its best is estimated to have been 100,000 times as luminous as the sun. Its distance from earth is estimated at 2,800 light years.

DROUGHT threatens the thirty million young trees that were set out in the shelterbelt area of the West before Congress doomed the whole project by cutting off all appropriations. The trees are still in good condition, but the soil around them will need cultivating unless the heavy investment already made is to be given us as lost. If work-relief is made part of the drought-relief program developed at the St. Paul conference, it is hoped that some of the funds may be made available for the protection of the shelterbelt plantings. All the remaining trees in the nurseries, over a hundred million all told, have been ordered to be dug up and given away by Congressional mandate. Probably most of these will perish, through lack of forestry knowledge on the part of the people who get them.

DROUGHT is not only an enemy in itself, it has given threefold aid to another enemy, the grasshopper. First, it has provided ideal living conditions, for 'hoppers love warm, dry weather. Second, it has stunted the crops, so that grasshopper feeding is that much more destructive. Third, by causing a shortage of all kinds of cattle feed it has boosted the price of bran, which is an essential ingredient of the poisoned bait used in the war against them. And with only a quarter of a million dollars of federal money available in the whole grasshopper area, any additional curtailment of the total munitions supply makes defeat in the campaign all the more likely.

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SCIENCE NEWS

Science Service, Washington, D. C.

AUTOMATIC WEATHER INSTRUMENTS ON BALLOONS

"ROBOT" weather instruments, carried high aloft on small unmanned balloons, proved their worth during the seventh annual National Soaring Contest at Elmira, N. Y. Each one automatically reported by radio the altitude of the balloon, relative humidity and temperature every minute throughout its flight into the upper atmosphere.

The information secured in this way has been added to the periodic meteorological data collected for the use of soaring pilots in their annual assault upon world and national records in motorless flight. The radiometeorograph ascensions have been conducted by representatives of the Blue Hill Observatory, Harvard University, Milton, Mass., under the direction of Dr. K. O. Lange, who has pioneered in the development of this new type of medium for collecting meteorological data.

The first ascension during the soaring contest was made from Harris Hill on June 27. The twin balloons needed to carry the tiny apparatus rose to an altitude of 68,000 feet and signals were heard for 64 minutes from the take-off time—4:10 in the afternoon. During the second ascension, made on the following day, the balloons carrying the instruments reached an altitude of about 80,000 feet and the signals were heard for 1 hour, 58 minutes. The balloons reached an altitude of about 100,000 feet on June 29, the signals being heard from 12:14 P. M. to 2:57 P. M.

A specially interesting ascension was made on June 29. The balloons were released after dark in the evening and were followed to 13,200 feet. At that point the signals began to record a descent. They were followed to a point where the temperature was lower than at the take-off site, indicating that the apparatus had landed. The failure of the balloons to go higher in this flight probably was due to the bursting of one of them.

Beginning in 1932, the contests conducted by the Soaring Society of America have had the advantage of the most advanced meteorological service available. The pilots were among the first in this country to be taught to use the air-mass system of weather forecasting and interpretation and the continuation of the Blue Hill Observatory experiments with the radiometeorograph through the two-week period of the contest is in line with the society's policy of investigating every promising medium for securing weather information.

DANGER OF DEATH FROM LIGHTNING

THERE is little chance of being killed by lightning in the United States, for only three persons in every million of the population have been struck down annually by electricity from the sky in the last ten years.

New figures compiled by statisticians of the Metropolitan Life Insurance Company show that, despite the low general mortality, there are areas, including New Mexico, Arizona, Georgia and Mississippi, where each year about ten persons in a million lose their lives from this cause.

Frequency of thunderstorms is an important factor, but workers in the outdoors are in much greater danger than city dwellers. In a city like New York, with many tall buildings built on a solidly connected steel skeleton, almost complete protection from death by lightning is afforded not only to the persons within such buildings, but also to those in the vicinity. These tall buildings act as most efficient lightning conductors, partly by dissipating the electric tension without any actual lightning discharge, and partly by receiving the lightning discharge when it does occur, and passing it harmlessly to the ground. It is a matter of relatively common occurrence in thunderstorms for these tall buildings to be struck without the slightest damage to the buildings or their occupants.

There is a continuous band of states, including Montana, Wyoming, Colorado, New Mexico and Arizona, running from north to south, characterized by annual death-rates of six per million and over; another continuous patch of states with these high rates is found in the southeast corner of the United States, including South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana and Arkansas. States bordering on these areas also had in most cases higher than average death-rates from this cause.

In contrast, the Pacific Coast States and the highly industrialized states of New England and the Middle Atlantic Division ranked as the least hazardous parts of the country as regards fatalities from lightning. Outstanding among the states with low rates may be mentioned California, with a population of approximately six million, where there have been only five deaths from lightning in a ten-year period studied, and the State of Washington with a population of approximately a million and a half and only eight deaths in the same period.

In the death registration area of the nation during the period 1924–1933 there were recorded 3,849 lightning deaths, the equivalent of 385 per year.

EFFECTS OF THE DROUGHT ON WILDLIFE

DROUGHT has developed a new menacing front in the Northwest—big game animals in the U. S. National Parks, now on parched pasturage, are threatened with starvation next winter through shortage of the hay crop that has ordinarily supplied supplementary feed.

The situation is most acute at present in Wind Cave National Park, a small park on the south slope of the Black Hills in South Dakota. Although the total number of bison, elk, antelope and deer on this comes to less than 500 head, lack of pasturage now and hay for next winter makes even this small number look like too much of a load.

In Rocky Mountain National Park there has long been a deer-and-elk problem, because the natural range north

of Estes Park is over-stocked, and efforts of the National Park Service to get it extended have thus far been unsuccessful. Glacier National Park, on the other hand, offers less of a problem, because the deer pasturage there depends primarily on winter snows, and these have been abundant even when the Plains have suffered from both summer and winter drought.

Yellowstone National Park of course has the biggest problems to face, because it supports the largest herds of big game, and because droughts of the past few years have left the range in bad shape. The present state of the range where the thousand buffalo feed is not accurately known at the moment, but a survey has been started. The ten thousand head of elk which constitute the so-called Northern and Gallatin herds are known to be a grave over-load on their natural range, but efforts to get more land have been stymied by the opposition of ranchers whose lands run up to the northern boundary of the park. The southern elk herd feeds in Yellowstone Park only during the summer, and lives most of the time outside the park boundaries, so that while it presents a serious problem, the responsibility for solving it does not rest primarily on the National Park Service.

Distress and possible wholesale starvation of the Yellowstone elk herds, the largest surviving groups of these animals left in the United States, will undoubtedly be intensified by the difficulty of procuring supplementary feed. In past "distress winters," public-spirited citizens have often dug down into their own pockets to purchase hay from outside sources, but this year they will have to bid against the urgent need for feed of all kinds to save the herds of domestic animals throughout the drought-swept Northwest.

VOLCANIC ACTIVITY ON THE ISLAND OF MONTSERRAT

MONTSERRAT, a small volcanic island in the British West Indies where Dr. Thomas A. Jaggar is now investigating the almost continuous disquieting earth tremors, has always been regarded as a "safe" island until the last few years. There is no record of anything like a real eruption since the first discovery of the island by white men.

In fact, the first description of Montserrat does not even mention its volcanic nature, except to refer to it as rugged or mountainous. For example, the encyclopedic "Accurate Description of the New World," published in 1671 by the English geographer John Ogilby, merely says:

"Montserrat, lying just at the seventeenth degree, is so called from a Spanish Hill beyond Barcellona, whose shape this Island represents off at Sea; It is about three Leagues in length, and almost as much in breadth, and is very Mountainous, except a little towards the East, and as much Westward. The English have a Church here, lin'd in the in-side with Cedar, which this Island produces in great abundance."

Montserrat's present activity seems to have begun in comparatively recent years, in a rather "simmery" fashion. Early in the present century the German volcanologist, Dr. Karl Sapper, was interested enough to land there and make a hasty reconnaissance of the island, during the course of an expedition devoted mainly to the investigation of the more formidable volcanoes elsewhere in the Caribbean region. At that time he reported that fumarolic and solfataric activity had apparently increased a great deal since the end of the nineteenth century, because he found many trees killed off, where they had previously grown unmolested.

Yet at some time there must have been major eruptive activity, for there are three major mountain masses on the island, all of which appear to be the much fragmented relics of a volcanic framework. The highest of these is Mount Chance with an altitude of about 2,900 feet; it is thickly wooded, and has a good-sized pond near its summit, in what appears to be a crater-pocket. Another peak, St. George's Hill, still has a definite crater form, though it is much eroded.

Montserrat is a small island, lying about midway between the Virgin Islands and the tragic French possession Martinique, devastated in 1902 by the explosion of Mount Pelée. It is about eleven miles long and three miles wide. It has the nickname of the "Emerald Isle of the Antilles," partly because of its green tropical beauty, partly probably because its 12,000 inhabitants are mainly of Irish descent. They are still noted, even in the hospitable West Indies, for their hospitality, and also for their easy wit and a tendency to "blarney."

THE EARLIEST ALL-AMERICAN BOTANY

AFTER existing for four centuries as a single manuscript copy, the oldest all-American botany book is to be put into print by the Smithsonian Institution, aided by generous contributions from private individuals and organizations.

The book is known as the Badianus Manuscript, and it is kept in the Vatican Library. It is a carefully written treatise on all the medicinal plants used by the Aztecs before the time of the Spanish Conquest, with accounts of the diseases they were supposed to be good for.

The work is by native Americans throughout. The original was written in the Aztec language by an educated Aztec named Martin de la Cruz, and was translated into Latin by another Aztec, Juannes Badianus. The illustrations are vividly done in colors, in the native Aztec style; they are still as bright as new, and most of them can be identified by botanists.

The task of translation and annotating the Latin and Aztec text was performed by Dr. Emily Walcott Emmart, of the Johns Hopkins University. Dr. Emmart was also active in finding the needed supplementary funds for publication.

The Badianus Manuscript is a monument alike to Aztec civilization and to the intelligence of the Spanish conquerors. The Conquistadores were not the mere brutal freebooters long pictured in popular histories. Close on the heels of the conquering soldiers followed able administrators, learned educators and zealous missionaries. Within a few years of the conquest, and a hundred years before Harvard College opened its doors, there was in

Mexico City an officially sponsored institution of learning for "sons of Indian gentlemen," with a faculty of Franciscan friars.

In this place, Santa Cruz College, the curriculum included all the subjects commonly taught in the European universities of the time, plus Aztec language and Aztec medicine. The friars taught the Indians how to write their own language (for Aztec had no alphabet of its own), and even made some of them fluent in Latin.

The redskinned Senores de la Cruz and Badianus collaborated in making a permanent record of Aztec medical and botanical learning in their little book, intended first for the eyes of the viceroy, and possibly of the Spanish king. The text is entirely in Latin, with the exception of the names of the plants themselves, which were wisely left in the original Aztec. And now for the first time the scientific world at large is given access to this treasure of early American knowledge, through the action of the Smithsonian Institution and the generosity of its friends.

ITEMS

NEW experiments with apples revealing that different apple varieties show marked differences in the amount of vitamin C they contain were reported to nutritionists, at the meeting of the American Home Economics Association, in Seattle. Using guinea-pigs to test the nutritive value of western apple varieties, Dr. E. N. Todhunter, of the State College of Washington, reported that apples lose vitamin C when stored. Destruction of vitamin C, he said, increases with the length of time apples are kept in storage and is progressively greater with storage temperatures above 32 degrees Fahrenheit. Dr. Todhunter also reported that the peel contains about half the vitamin C value in an apple.

SEATTLE'S experiment in requiring meat to be graded, watched by cities throughout the country, is giving the public better beef with no advance in price. So the American Home Economics Association, meeting at Seattle on July 1, was told by Dr. F. E. Smith, of the Seattle Department of Health and Sanitation. Seattle is the first city in the United States to make the grading of beef, mutton and lamb compulsory. The system, now in use for a year and a half, was developed by the U. S. Bureau of Agricultural Economics with the idea of marking meat in a common language understood by both buyer and seller. Describing the meat grading system as "a service rendered to consumers, which protects them against fraud and misrepresentation," Dr. Smith said that opposition to the system continues "stubborn and persistent."

DIFFERENT colors of light not only produce different rates of growth in plants, but in some way cause neighboring seedling-tips to seek or shun each other, according to Dr. Enoch Karrer, of the Smithsonian Institution. Dr. Karrer grew large numbers of oat seedlings, and exposed sets of them to the rainbow-band of light obtained by splitting up the white light of an electric arc. Seedlings exposed to blue light showed the expected reaction of bending toward the light. But they also showed an unexpected reaction: they also bent toward each other. Red light produced an opposite "social" effect: red-illuminated oat seedling tips bent away from each other. Plants receiving orange light became greener than their neighbors, while those receiving only blue-green light developed the most marked yellowish color. Roots grew longest in the extreme blue and shortest in the orange-red.

THE biggest beast that ever trod on dry land, Central Asia's giant Baluchitherium, is now shown as he was in life, at the American Museum of Natural History, in a restoration sculpture which will be placed on display in the near future. Museum artists are now putting the finishing touches on the enormous image, which mounts a body as big as two elephants on top of massive six-foot-high legs. Towering higher than any living giraffe, the Baluchitherium was a primitive representative of the rhinoceros family. It lived some 25,000,000 years ago, when what is now the Gobi Desert was a well-watered, richly vegetated land. The genus was given its name, which is rather loose-jointed Greek for "beast of Baluchistan," because its fossil remains were first found in that country.

PHYSICIANS and surgeons are viewing with interest a report presented at the meeting of the American Institute of Electrical Engineers that an Italian, stabbed in a fight and about to die on an operating table, was brought back to life when the surgeon applied a counter-shock previously given animals in experiments to revive them after suffering an electric shock. Dr. William B. Kouwenhoven, assistant dean of the School of Engineering of the Johns Hopkins University, reported how a surgeon, while sewing up the Italian's heart, saw from the fibrillation of the organ that he would die, and gave him an electrical counter-shock. The surgeon had previously visited the Hopkins laboratory. It took two days to convince him by experiments on animals that counter-shock is effective in reviving the fibrillating heart. The surgeon, whose home city and name was not disclosed, previously skeptical but convinced by actually making experiments in the Hopkins laboratory, is believed to be the first man to apply the counter-shock principle to reviving a human being.

DR. HOWARD L. EDER, of the Santa Barbara Clinic, has found that new-born babies get a better start in life when they are fed a special sugar solution and sodium citrate during their first few days. The sugar solution, a combination of maltose and dextrin, is already widely used as a supplement to cow's milk in infant feeding. Combining sodium citrate with the sugar solution is the new departure. In a report, appearing in the current issue of the *Archives of Pediatrics*, Dr. Eder states that this solution lessens the weight loss following birth and prevents the acidosis, fever and jaundice which "have been a grave source of concern to the medical profession for many years." Babies given the citrate-sugar mixture regain their birth weight more rapidly, nurse more vigorously and are in generally better condition.

SCHOOL AND SOCIETY

EDITED BY J. McKEEN CATTELL

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SCIENCE NEWS

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ADVANCES IN SPECTRUM ANALYSIS

A NEW method of analyzing blood and other body fluids, capable of detecting elements present to the extent of only one part in a hundred thousand, was explained at the conference on spectroscopy at the Massachusetts Institute of Technology at its opening session on July 20.

The ultra-penetrating eye of science's master key of investigation, the spectroscope, forms the basis for the delicate and precise analysis. Dr. O. S. Duffendack, of the University of Michigan, who developed the new technique along with Dr. Kenneth B. Thomson and Dr. William C. Lee, also of Michigan, told the conference that only two drops of the solution being tested are needed for the investigation, a decided advantage over other methods of analysis in that large amounts of complex body fluids are often not available to investigators. Dr. Duffendack's technique also has the advantage of being considerably speedier than the usually employed chemical analysis while losing none of that method's precision.

The method was developed particularly for the analysis of urine, blood and other body fluids for sodium, potassium, calcium and magnesium. And Dr. Duffendack has found that the method also works well in ferreting out minute traces of aluminum, chromium, copper, nickel, iron, silicon and similar substances in electroplating solutions, caustic liquors and other industrial chemicals.

There are two variations of the method as developed by Dr. Duffendack, each with its own peculiar advantages. In general principle, both employ fundamental spectroscopic technique, spreading the light given off into the colors of the rainbow. Each of these lines, or colors, tells a story, enabling the scientist to see what elements are present by identifying them from their peculiar tints.

The first variation employs a 25,000-volt inductive spark, maintained between two electrodes which are in reality composed of the solution under analysis. A minimum of nine cubic centimeters, only a few tablespoonfuls, of the solution is required for the test, but the method regularly yields results with an average error of approximately three per cent.

The second method utilizes a high voltage alternating current arc between spectroscopic carbons upon which a drop of the solution under analysis has been evaporated. Thus only two drops of the solution are needed for the experiment, a valuable factor in the study of body fluids and other solutions available only in extremely small amounts. This method also has the added advantage of detecting elements present in exceptionally small amounts in solutions containing large amounts of other substances.

NEW TECHNIQUE IN SPECTROSCOPY

A NEW method of snapping science's valuable spectroscopic pictures, which adds another "dimension" to the photograph, thus enabling investigators to ferret out minute traces of elusive elements and even to determine in what compounds various metals are present, a heretofore impossible task, was reported to the conference by David Richardson, research fellow in physics. The discovery may be said to sharpen science's already keen tool, the spectroscope. Many among the 100 scientific men attending agreed that this new technique will greatly increase the value of spectroscopy.

Ordinary spectrum photographs show the chemical elements present in the substance and tell roughly in how great amounts they are found. The pictures are snapped in a manner generally resembling that used in taking ordinary snapshots.

By moving the photographic plate upward at a constant rate throughout the exposure, instead of keeping it stationary, Mr. Richardson has added another "dimension" to his picture, which makes it possible to determine what is occurring at any instant during the exposure.

The greatest advantage of the new technique is its ability to tell the investigator in what chemical compound a given metal is present, an analysis not possible with ordinary methods. The standard technique, for example, can detect sodium, iron or any other element, but does not say whether the compound in which it was present was a chloride, a nitrate, an oxide or some other compound. With Mr. Richardson's technique this is possible, for the width and brightness of the line that reveal the presence of a metal can also be made to divulge the negative radical, the element with which it is associated in the compound.

The addition of the time dimension also enables the scientist to identify minute traces of an element which would escape detection under ordinary methods, and also to determine more accurately than by other methods the amount of a substance present in the material under investigation.

TANDEM BALLOONS TO RECORD COSMIC RAYS

TANDEM stratosphere balloons—four or more gas bags launched tied together—are about to be set free at San Antonio, Texas, by Dr. Robert A. Millikan and Dr. Victor Neher, of the California Institute of Technology, in a new attempt to extend their researches upon cosmic rays. Extremely sensitive and light apparatus will be carried to heights that are unattainable with manned balloons and airships. Not until rockets are perfected is there any hope of reaching the distances above earth that the Millikan-Neher balloons promise to attain.

At extreme elevations of between 15 and 20 miles the recording instruments will be bombarded with cosmic radiations hundreds of times more intense than at sea-level. Moreover, some of the most interesting rays never get down to more accessible regions at all.

Five flights are planned. With the breaking of one of the balloons in a tandem string, the journey of the instruments back to earth will begin. Each balloon

leaves the earth inflated to a diameter of four feet and at the highest, or bursting altitude, it reaches a diameter of about fifteen feet. The fall of instruments to the ground is broken by the automatic opening of a parachute.

Each flight will take only a few hours, but high winds in the stratosphere may carry the balloons several hundred miles. Drs. Millikan and Neher hope that at least half the instruments will be found after their fall to earth and will be returned to them. In addition to receiving a small cash reward, the finders will be performing a service useful to science.

The instruments carried aloft by the balloons weigh only two pounds. Yet they contain five devices of special design and automatic operation. These are the cosmic ray electroscope designed by Dr. Neher, a camera, a clock, a thermometer and a barometer. Dr. Millikan is the pioneer in this type of cosmic ray research and the instruments used were developed at the California Institute of Technology.

Records obtained in the flights will be specially important because there is very little information about the cosmic rays in the stratosphere at such low latitudes as San Antonio. Low latitude observations are considered important because they show how much of the cosmic radiation is composed of charged particles which can not easily approach the earth in those low latitudes because of the magnetic field of the earth there.

POLIOMYELITIS IN THE SOUTH

No indications are seen by U. S. Public Health Service officials that the infantile paralysis (poliomyelitis) epidemic in Alabama and Tennessee will reach national proportions. Reports from other parts of the country show no unusual amount of the disease. Federal health authorities are also encouraged by the fact that the Alabama-Tennessee outbreak is not so severe as the North Carolina epidemic of about the same time last year. Nor does it show any great tendency to spread.

Federal "H-men" led by Dr. Charles Armstrong have gone into the affected areas in order to aid in the application of the new nose spray which it is hoped will prevent the disease. Developed by Dr. Armstrong and Dr. W. T. Harrison as the result of experimental work on monkeys, the alum-picric acid nasal spray is receiving its first large-scale application in this epidemic.

In the hope of saving some of those who might otherwise fall victims, the nasal spray is being used without any attempt at making a controlled experiment. Physicians and health officers are administering the spray, which is quite harmless, to those who desire it and who can be treated with the facilities available. Undoubtedly a study will be made later to determine whether any cases of poliomyelitis occur among those who are treated with the spray, but there is no systematic exclusion of some from the treatment in order to have a "normal" group in which the disease might have an unhampered chance to spread, as would be the case if the doctors were conducting a laboratory experiment.

U. S. Public Health Service officers are careful to state that the alum-picric acid spray method is "based entirely upon animal experimentation" and "is not at present to be regarded as of proved value in the prevention of poliomyelitis in man." Nevertheless, they are hopeful that it will prove effective in preventing the disease and that this epidemic may give some evidence to that effect.

In last year's North Carolina epidemic there was experimental use of vaccines designed to provide artificial immunity to the disease. In the time subsequent to that use medical opinion has developed which has indicated that vaccines should not be used.

TREATMENT OF VARICOSE ULCERS

A NEW method of treating varicose ulcers which appears more satisfactory than any treatment hitherto suggested is described in the *Journal* of the American Medical Association.

Twenty-six persons have been treated by the new method for this chronic condition after from one to thirty-seven years of suffering during which time all recognized forms of treatment had been tried on one or more of them. All except three were healed after treatments extending over periods of from one to twelve weeks.

Dr. Leslie Saylor, of Topeka, Kans., and Drs. Joseph Kovacs, A. Wilbur Duryee and Irving Wright, of New York City, make the report to the medical journal. Their experimental work was done at the vascular clinic of the New York Post-Graduate Medical School and Hospital of Columbia University, aided by a grant from the Josiah Macy Jr., Foundation.

During the new treatment none of the patients was put to bed or sent to a hospital. They continued their daily occupations of washing, ironing, cooking, chopping wood and selling real estate.

In treating the varicose ulcers, the doctors saturate a reinforced asbestos paper with a 0.5 per cent. solution of acetyl-beta-methyl-choline chloride and wrap it around the patient's foot and leg as high as the knee. A metal plate is placed over the wet asbestos paper and connected to the negative pole of a galvanic machine. The current is then turned on. Half-hour treatments are given two or three times a week. The metal plates are never applied over the ulcerated area.

This form of treatment has especial value, the four physicians assert, in cases in which ulcers do not heal after the injection treatment for varicose veins or in cases in which injections are not to be recommended as, for example, with diabetes or phlebitis.

THE YELLOWSTONE ELK

YELLOWSTONE'S ten thousand elk of the Northern Herd face starvation and death during the coming winter, because of the unprecedented failure of their rangeland and of the fields where hay is normally grown for their winter use. A survey of the situation shows a falling off in density of forage vegetation of 27 per cent., as compared with the figures for last year.

Not only is the total amount of vegetation decidedly less, but what is left is qualitatively less fit for animal consumption. The palatable grasses have been largely

burned out or eaten off to the roots. Their place is taken by various kinds of undesirable weeds and unpalatable brush. This means not only bitter hard times for the elk during the coming winter, but also very slow recovery of the one-time rich game rangeland. The pasture will be years, perhaps decades, in coming back.

"Perhaps the most distinct indication of volume of forage that will be available during the coming winter is the height of forage plants," the report continues. "The average height of all plants examined in the plots is 65 per cent. less than in 1935. In several instances the quadrats examined did not contain a single grass seed stalk, while in the previous year a good seed crop was produced. Seedling crops have been totally lacking this year or have died due to weather conditions.

"Unusually high temperatures along with hot, dry winds melted the snow in early April and caused very rapid run-off. The rapid melting of snow did not permit the soil to absorb a normal, or even a slight amount of moisture. An abnormally dry period followed in May, and in the Gardiner area only .21 inches of precipitation was recorded during the month.

"June had a more normal rainfall, but this was largely offset by high temperatures and the fact that rainfall occurred in a short time with run-off high. Combined with the high temperatures were several wind and dust storms that greatly increased evaporation.

"It is obvious to the layman examining the winter game range that a critical condition exists, and that action is necessary to even maintain forage at its present status."

ITEMS

THE U. S. Biological Survey has informed Science Service that small wild animals in the drought area are suffering less than live stock. Such lesser native creatures as prairie dogs, rabbits, ground-squirrels, and the owls, hawks and snakes that prey upon them, manage to pick up a living when pasture had failed for the bigger beasts. The Biological Survey discounts stories of wholesale migrations of jackrabbits from South Dakota into Nebraska. Migrations have occurred from time to time, but they are always more or less local affairs. Jackrabbits were never mass migrants like their old-time bigger neighbors, the bison.

GRASSHOPPERS have an ally in a related insect, the Mormon cricket, in the northern Rocky Mountain area of Montana and Idaho, and also in Nevada. These crickets, big, clumsy, non-fliers with tremendous appetites, have been raising a great deal of trouble in their limited range. They do not threaten to spread eastward, for the Mormon cricket is distinctly an insect of the Far West. Appeals continue to come in to the U. S. Department of Agriculture for more poison-bran bait for the still unconquered grasshoppers throughout the West, but there is nothing more to send. The small appropriation provided by the Congress in the pre-adjournment rush is totally exhausted, and no more funds are in sight.

VIOLENT storms, such as struck Pennsylvania, New York and other parts of the country, are normally to be expected when a persistent and intense heat wave is broken up by the coming of cooler air masses. The sharp contrast between temperatures, and hence of densities, of the adjacent air masses causes rapid rising currents and overturns in the atmosphere, which often produce hailstorms and sometimes tornadoes. Although the Weather Bureau usually knows when the atmosphere is thus loaded with "air dynamite," it never issues tornado warnings, as it does warnings of hurricanes in the Gulf and South Atlantic regions. This is because it is impossible to tell whether a tornado will merely spend itself in the air, as such twisters frequently do, and also because the exact path can not be forecast even if it does swing down to the ground.

A TWO-AND-A-HALF-TON battery of three star cameras, the largest using plates two feet wide, has been placed in operation at the private observatory of Dr. Gustavus Wynne Cook, located at Wynnewood, Pa. The largest camera battery of its kind in the world, Dr. Cook will use it to make a series of photographs of the entire Milky Way. After photographing all the Milky Way area that is within reach from Wynnewood, Pa., he expects to move the equipment to South America or South Africa, so that regions of the sky which never rise in the Philadelphia area can be recorded. The three cameras take pictures on plates 20 by 24 inches, 14 by 17 inches and 8 by 10 inches. They are equipped with lenses, 6½, 5 and 4 inches in diameter, of a type invented by Dr. Frank E. Ross, of the Yerkes Observatory of the University of Chicago. There is a guiding telescope with 4-inch lens by means of which the photographer can keep the cameras accurately pointed at a selected part of the sky.

A SURGICAL operation on a Chicago medical student was interrupted recently and an x-ray picture was taken of the young man's kidney, which the surgeons had exposed. From a study of the x-ray films, Drs. Herman L. Kretschmer and Faye F. Squires, of Presbyterian Hospital, were able to make a diagnosis of tuberculosis of the kidney, thus satisfying themselves that the organ should be removed. The doctors had suspected renal tuberculosis, but when they exposed the kidney it appeared normal and they were undecided as to whether or not it should be removed. The x-ray pictures cinched the diagnosis. This rare use of the x-ray machine is reported by the two surgeons in the *Journal* of the American Medical Association.

THE new fashion of black clothing for summer wear has no support from those who understand problems of heat. It might do for evening wear, but don't don a black dress and go out in the sun if you want maximum comfort. Rough black surfaces are the best absorbers of heat known to science. Smooth, bright surfaces reflect or turn away the heat. Science, therefore, does give support to the new bright helmets the boys are wearing. Another warning about summer clothing—it is not the fabric that is loosely woven with wide air spaces between fibers that is the coolest. Air makes a good insulator for holding the heat of the body in. Wool clothing and furs are warm because the fibers are small and hold plenty of air between them. Linen is a cool fabric because the fibers are large and it has few air spaces.

SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS READ AT THE ROCHESTER MEETING OF THE AMERICAN ASSOCIATION AND ASSOCIATED SOCIETIES

FLOOD control problems motivated a three-cornered scientific get-together at the summer meeting of the Ecological Society of America, where three lines of scientific activity—forestry, soil conservation and engineering—pooled ideas and suggested ways and means for combating the national menace of great waters broken loose. Participants in the symposium were Ferdinand Silcox, chief of the U. S. Forest Service; Dr. W. C. Lowdermilk, associate chief of the Soil Conservation Service, and Dr. Morris L. Cooke, head of the Rural Electrification Administration. The speakers were unanimous in the opinion that flood problems in the great stream valleys can not be met wholly on the spot, but that the ultimate effective efforts must be put forth far upstream, where the "little waters" are. To achieve flood control, said Mr. Silcox, we must "lift up our eyes unto the hills"; in them lies the danger, and from them must come the help. For there our little waters rise; there man may restore and protect that vegetative cover which forms nature's own great reservoirs and settling basins, dams, revetments and levees. And there, he points out, are the National Forests. Flanking the Appalachians from New Hampshire to Georgia; abutting the Great Lakes and dotting headwaters of the Mississippi; blanketing the Rockies from Canada to Mexico, the Cascade, Sierra and Coast Range mountains from north to south, they offer an opportunity and a challenge to ecologists, foresters and engineers alike. Maintenance of their forest, forage and other vegetative cover is vital to flood control. Foresters believe that if each drop of water is held for a time in the soil where it falls, there will be lesser volumes of water than now pile up in lower reaches of our rivers; that man's mighty engineering works alone can not wholly prevent death from stalking through the lowlands; that to do this, conditions which serve to hold back rains at the headwaters must be restored, improved and maintained. Flood control must start, not with raging torrents of the lower Mississippi, but with raindrops and rivulets in places far from the haunts of man.

FROM single falling raindrops man can learn the beginnings of wisdom regarding soil conservation, Dr. Lowdermilk told his audience. When a drop falls, it splashes into a spray of clear water if it strikes a leaf or grass-blade or anything else than bare, unprotected earth. The spray settles upon the soil and is absorbed, with little or no surface runoff. But if the drop falls on bare earth, it splashes up not clean but muddy. The fine particles in the muddy spray, as it falls back to earth, "filter out at the surface to form a thin film which chokes up the surface pores of the soil. Only a part of the drop goes into the soil, another part flows over the surface, and by the accumulation of infinite drops, superficial flow is formed. As streamlets enlarge, the waters are released from surface frictional forces; the velocity of flow rapidly accelerates and generates erosive power. The rampant waters become gully-washers, to coalesce into raging torrential flows." Another thing that prevents the soil from absorbing its proper quota of water is the presence of imprisoned air. In the aggregate these air bubbles imprison tremendous quantities of soil and keep it dry, when plenty of water is available. Roots, stems of plants and other organic objects act as innumerable air-shafts to let this trapped air escape and permit down-soaking water to seep in behind it. Very little attention has as yet been paid to this function of roots and stems and a great deal of careful study is therefore needed to understand it and take practical advantage of it.

ENGINEERS no less than biologists and earth scientists must look upstream, in the opinion of Dr. Cooke, himself an engineer. Largely because of immediate business demands, but partly through lack of vision, engineers have always concentrated on enormous works on the big waters and they have let the little waters go unheeded and untamed. This policy, quite understandable but none the less dangerous, has contributed to historic flood disasters. Engineers have frantically thrown up higher and higher levees—and the great rivers have eventually met and broken all their challenges. Now engineers are realizing more and more the necessity of taming the little waters before they become too great to tame. Engineering begins to look upstream. Such wide-spread attack on the origins of the problem that masters all human effort if permitted to concentrate in the great valleys must involve a different economic outlook from that which has always governed engineers and their private employers, Dr. Cooke pointed out. Business men say they are "not in business for their health," and they are justified in saying so. But the community at large it not in business for anything else but its health, and for this reason intangible values must be taken into account when the cost of a given large-scale project in control engineering is being reckoned. Engineers must become accustomed to looking out over a terrain that is nation-wide, and to seeing things in the large. Piecemeal engineering is doomed to be beaten piecemeal by the unbridled forces of nature. But engineering conceived and executed in regional and national terms has a chance to conquer.

DR. C. G. ABBOT, secretary of the Smithsonian Institution, Washington, known for his studies on solar variations, reported that more accurate and more continuous day-to-day observations of solar radiation will allow forecasting of some features of the weather two weeks in advance. For the new method of weather forecasting an extension of the present solar radiation observations of the Smithsonian Institution will be needed. At present, there are three observatories on high mountain peaks

in desert regions. If financial support can be obtained for adding seven observatories to those now operating, the necessary weather forecasting information will be obtained. Another way of obtaining the information would be to use balloons that sail above 100,000 feet (about 20 miles) carrying with them extremely lightweight instruments that record the sun's radiation and flash their findings *via* short-wave radio to the earth.

As the use of unmanned robot radio balloons becomes more common in weather services and upper air it should actually be cheaper than airplane flight at less than one fifth the height, Dr. Karl O. Lange, of Harvard Observatory, told the American Meteorological Society. The secret of the new system of air-mass analysis weather forecasting, Dr. Lange indicated, hinges on daily information of air temperature, pressure and humidity at very high altitudes. The use of airplanes carrying aloft instruments on special "weather" flights is now practiced, but investigators are turning to the tiny, light radio balloons to reach still greater heights at less cost. At present the radio-balloon flights going up twenty miles cost only 50 per cent. more than an airplane flight to 17,000 feet. Quantity production of the radio balloon equipment will decrease the cost below airplane flight.

SPRAYS of electrified particles shoot out, now and then, from all kinds of matter. Rocks, metals, even our own bodies, are subject to this effect which physicists say is due to the unceasing cosmic-ray bombardment. But it now seems more likely that the atoms remain intact during the collision and that the cosmic rays suffer the major damage. According to Dr. and Mrs. Carol G. Montgomery, of the Bartol Research Foundation of the Franklin Institute, the spray particles are pairs of positive and negative electrons created in that intense electric field which surrounds the nucleus of every atom. The raw material for the process is the energy of the cosmic-ray photons. Speaking before a meeting of the American Physical Society, Dr. Montgomery described experiments which he and Mrs. Montgomery performed with a device called an "ionization chamber." Different kinds of material—lead, tin, iron, magnesium—were piled about the chamber and their electrical effects recorded on yards and yards of photographic film. The heavier the material surrounding their chamber, the larger was the number of particles shot out in every spray. Heavier atoms have stronger electric fields about them; have greater power to rip cosmic-ray photons apart, as it were, and convert the pieces into pairs of electrons.

THE red blood cells of man and animals as carriers of electricity are being studied at the Biological Laboratory, Cold Spring Harbor, Long Island. Dr. Laurence S. Moyer and Dr. Harold A. Abramson reported that red blood cells of man, among the animals studied, have the highest effective electrical charge at their surface, equivalent to 15,000,000 electrons. Studies of the amount of electricity carried by the blood cells have important relationship to such basic human problems as the coagulation properties of the blood and problems connected with the anemias. For example, it has been found that in certain cases of anemia in human beings, the abnormal cells apparently possess a mechanism which is capable of preserving the normal surface charge of the cell in spite of wide variations in the surface area during the course of the disease. Of all the animals studied in the tests, Drs. Moyer and Abramson found that the rabbit had the lowest electric charge density—only 1,890 electrostatic units. Man and the rhesus monkey (used in experimental studies of infantile paralysis) had about the same charge density, 4,500 units. The dog had the highest charge density, 5,600 electrostatic units.

EXPERIMENTS on the effect of the new neutron rays of science to produce biological changes in living organisms show that they are much more efficient than x-rays, according to Dr. Raymond E. Zirkle, Johnson Foundation for Medical Physics at the University of Pennsylvania. Ultimate hope of the investigators, Dr. Zirkle revealed, is that the neutron rays will be more destructive to tumorous tissue than to normal body tissue and that medical science will thereby have a more potent radiation with which to attack cancer. He stated that "the results to date do not yet justify the prediction of such an extremely fortunate outcome, but are nevertheless distinctly encouraging." The neutron—one of the fundamental building blocks out of which atoms are built—was only discovered in 1932. Even yet the sources for creating neutron beams for biological study are so weak that only beams of low intensity can be used. But the encouraging thing is that the effectiveness of neutrons in ionizing tissue (which is the way all rays act on biological material) is always greater than x-rays for equal incident intensities. The relative effectiveness has been found to be from three to ten times in favor of the neutrons. Moreover, and still more encouraging, the neutron-x-ray ratio of effectiveness is not the same for all living tissue. "This is of tremendous importance," according to Dr. Zirkle.

IN the Maiben lecture before the American Association for the Advancement of Science Dr. Charles Camsell, deputy minister of mines of Canada, described an airplane expedition that covered 4,000 miles. He tried, without success, to find the so-called "tropical valley" of northwestern Canada. Although the legend had persisted for many years, it was found to be pure fiction. There are, however, unexplored areas still awaiting the adventurous geographer. The Mackenzie Mountains, the greatest single mountain group in the whole of Canada, are, to a large extent, unexplored and their structure and history are unknown.

THE first scientific proof that magnetism has an effect on living things was presented by Dr. Grace Kimball, of Cornell University. Young yeast cells were exposed to the magnetic field of a permanent horseshoe or bar magnet for a short period of time. The weakest field used for the work was 25 times stronger than the earth's magnetic field. "A noticeable inhibition of budding" was observed as a result of the magnetic force. The number of buds produced by the yeast cells under the magnet was 20 to 30 per cent. less than the number put

forth by yeast cells farther away from the magnet. When the magnet was shielded by substances which do not affect the magnetic field, such as glass, zinc or paraffin, the inhibiting effect remained, but when the magnetic field was cut off by iron, there was no inhibition and the yeast cells continued to bud at the normal rate.

NEW advances in studying the tuberculosis germ were reported by Professor R. J. Anderson, of Yale University. By analyzing these germs, Professor Anderson is learning what chemicals they use to produce disease in man and other animals. In wax obtained from the germ he has found complex sugars, fatty acids and a new alcohol which are peculiar to the human tuberculosis germ and are not found in waxes from any other bacteria. The part these different tuberculosis germ chemicals play in producing the disease has not been completely established, but Dr. Florence Sabin, of the Rockefeller Institute for Medical Research, has found that the new acids and the optically active alcohols of the wax from the tuberculosis germs are remarkable stimulants to cells, especially the type of cells that form fibrous tissue and tendons in the body, the white blood cells known as monocytes and foreign body giant cells.

DR. GEORGE PACKER BERRY, of the University of Rochester School of Medicine, reported the production of a malignant 100 per cent. killing tumor disease in rabbits by injecting into them a virus of a non-fatal skin disease to which had been added some completely heat-killed virus of the deadly disease. No disease, whether caused by bacteria or filterable viruses, had heretofore been changed into another.

BY aid of delicate chemical tests dry bones of Egyptians who lived 3,300 years ago can be made to give up secrets regarding types of blood that once flowed in their veins. Announcement of the tests was made by Dr. P. B. Candela, Brooklyn physician, who used skeletons of Egyptian women who lived in the days of Egypt's eighteenth dynasty, 1500 B. C., now in collections of the Brooklyn Central Museum. It has been possible, said Dr. Candela, to prepare blood-group maps of the world showing that various races in different parts of the world are mainly of one blood type or another. American Indians, Celts and Basques belong predominantly to type two. Groups as dissimilar as Hindus, Patagonians and Amazon tribes are classed by blood mainly as type three. That this evidence points backward toward some significance in the early history and origin of human races was realized. But to trace that significance required evidence about blood types of ancient men dead thousands of years, and this information seemed lost beyond recall. Recent tests, however, have showed that mummified flesh of Egyptians and Indians can be made to reveal blood types. Dr. Candela's research extends the technique to dry bones, thus opening up the way for science to learn the blood traits of early men even in the Old Stone Age.

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SCIENCE NEWS

Science Service, Washington, D. C.

CHLOROPHYLL AND SUNLIGHT

POSITIVE evidence that sunlight acts on certain seeds through chlorophyll, the green coloring matter of vegetation, was presented to the conference on spectroscopy at the Massachusetts Institute of Technology by Dr. Lewis H. Flint, of the U. S. Department of Agriculture. The discovery opens a new approach to the study of light in relation to seed sprouting and growth, plant metabolism, the distribution of plants and other equally important allied problems of the science of life.

The research leading to the find was a continuation of that which Dr. Flint has been conducting on the effects of varying wavelengths of light on lettuce seed. Two years ago he reported to the conference that violet-blue light ranging between 4,400 and 4,800 Angstroms and nearly infra-red light at about 7,600 Angstroms inhibited the growth of the seeds. Yellow, orange and some types of red light, however, ranging from 5,200 to 7,000 Angstroms, were found to promote growth. This year he announces he has narrowed the limits of the growth-giving light and that the reddish-orange light in the vicinity of 6,700 Angstroms was best for plant growth. But most significant was the additional discovery that chlorophyll, the green coloring pigment, present in the seeds as well as in grown plants, absorbed more light at this 6,700 point and in the two inhibiting ranges than at any other bands.

"Here is an instance," he said, "in which the apparent critical wavelength of radiation promoting germination coincides with the major absorption in this region by a pigment common to all green plants. The radiation most effective in promoting germination in the seed is that most effectively absorbed by chlorophyll in the same region.

"In the violet-blue region a similar situation exists—the radiation most effective in inhibiting the germination is again that most effectively absorbed by chlorophyll. Thus chlorophyll becomes almost inevitably identified with the reactions of the seed to light, although it should be noted that the absorbed red light promotes germination and the blue light inhibits it.

"Blue light produces a set of physiological reactions quite different from that promoted by reddish-orange light, yet both groups of radiation appear associated with absorption of the respective sorts of radiation by chlorophyll. The close analogy places a distinct emphasis upon a new and promising viewpoint."

Dr. E. D. McAlister, of the Smithsonsian Institution, cooperated in the research.

SPECTROSCOPE TO CONTROL IRON CASTING

ROUTINE spectroscopic analysis of alloy cast iron by means of the light given off when it is highly heated was reported by Dr. H. B. Vincent, of the University of Michigan, before the conference at the Massachusetts Institute of Technology.

Research by Dr. Vincent, A. M. Sampson and Professor R. A. Sawyer has reduced the method to a routine operation of the use of instruments so that it may be handled successfully by the personnel of a production chemical laboratory. Most methods require the services of an expert spectroscopist and are controlled to some extent by guesswork.

Others had tried to perform analyses of iron and installations have been made, but were soon abandoned. The new method has been used for the analysis of cast iron in an industrial laboratory on foundry work for a period of six months and has given excellent results.

In his research Dr. Vincent found, as have all the scientists reporting at the conference, that the spectroscope is much more rapid than chemical methods, requiring less personnel for the same number of analyses. In addition to this high speed, low cost and very satisfactory accuracy feature the method.

Professor Sawyer, who worked with Dr. Vincent and Mr. Sampson, reported methods of analysis of other iron alloys, adapting the spectrograph to routine analytical foundry control. Each hour samples of at least eight different kinds of cast iron are analyzed to determine the amounts of six different constituents, copper, chromium, molybdenum, manganese, nickel and silicon.

"The 48 determinations involved can be reported by two spectroscopists with an accuracy of plus or minus 5 per cent. of the amount present in approximately 45 minutes," Professor Sawyer said. "The equivalent amount of chemical analysis by the methods in present use would require at least six chemists. A large saving is thus made, although chemists are still required for special analyses and control of sulphur, carbon, and phosphorus, which we are not yet handling, although we have developed methods for some of these elements."

Particular feature of this method, he said, was the great control possible over the sensitivity of any particular constituent.

SUBSTITUTE FOR EYE IN COLOR MEASUREMENT

SCIENCE is on the search for an eye-surpassing instrument that will measure light and color with as much reliability and ease as a voltmeter and ammeter measure electricity.

Dr. Herbert E. Ives, physicist of the Bell Telephone Laboratories, speaking before the Massachusetts Institute of Technology color conference, explained that such an instrument would be a definite improvement over the eye, not only because eyes vary from person to person, and tire easily, but because the eye is useless as an indicating instrument and can be employed only in comparative methods.

This ideal instrument has not yet been perfected, where highest accuracy is desired, for even the supposedly "infallible electric eye" or photoelectric cell has definite faults, although it has proved of great use because of its gains in speed and simplicity in routine measurements.

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JULY–AUGUST

Early Man in America with Particular Reference to the Southwestern United States:
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The Association of a Human Culture with an Extinct Fauna in New Mexico. Edgar B. Howard.
The Succession of Mammalian Forms within the Period in which Human Remains are Known to Occur in America. Professor Chester Stock.
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Symposium on the Species Problem of the American Society of Zoologists and the American Genetics Society: Species Studies and the Species Problem. Professor W. H. Longley. **The Distribution of Physiological and Chemical Peculiarities in the "Natural" Groups of Organisms.** Professor A. C. Redfield. **Interspecific Sterility.** Dr. Curt Stern. **Genetic Aspects of Certain Problems of Evolution.** Professor E. M. East.

The Phylogeny of the Adrenal Gland. Dr. Geoffrey Bourne.

Shorter Articles and Discussion: Hybrid Vigor in Maize: Eric Ashby. **The Structure of the Chromosomes of the Salivary Gland of Drosophila melanogaster:** Alfred Marshak. **Isolation and Growth Characteristics of the "Zoochlorella" of Paramecium bursaria:** John B. Loefer. **The Relation between b and k in Systems of Relative Growth Functions of the Form $y = bx^k$:** Hyman Lumer. **Species from the Genetic Standpoint:** Professor Robert K. Nabours.

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Imperfect in ordinary light measurement, electric eyes were for a long time out of the question in the complicated field of color measurement. Even with the development of new kinds of cells, which partially removed this obstacle, they have not been too satisfactory, for varying types are sensitive only to particular colors of the rainbow.

Cells consisting of caesium oxide, for instance, are most sensitive to wavelengths in the infra-red end of the spectrum. Others of potassium hydride are most sensitive in the visible part of the spectrum. These are somewhat comparable to the human eye, which is most sensitive to the middle part of the visible spectrum, that is, to greens and yellows, rather than to blues or reds.

By using several of these special cells, each of them sensitive to various parts of the spectrum, Dr. Ives has found that it is possible to obtain more accurate color measurement than any one individual cell can record. This cell grouping has the added advantage of eliminating errors due to scattered light of different wavelengths.

TELEVISION IN GERMANY

THE Olympic Games in Germany mark a milestone in the history of television, according to a prediction by Dr. Rolf Moeller, engineer of Fernseh, A. G., the German television company, who is returning to Germany after a television survey of England and the United States.

Dr. Moeller spent some time at the laboratories of Farnsworth Television Incorporated, Philadelphia, the American associate of Fernseh; obtaining final data toward the perfection of arrangements for the televising of the games in Germany.

Regarding this important event, Dr. Moeller said: "Television laboratories in Germany are very busy developing new things, especially in the field of the electron camera, in order to be prepared for the televising of the Olympic Games. This will be a milestone in the development of television in Germany. Several electron cameras will be placed about the stadium to pick up scenes of action."

The intermediate film process, for the invention and development of which Dr. Moeller is largely responsible, makes it possible for scenes to be shown in motion picture theaters on large screens, via television, in less than three minutes after they happen at the stadium.

In this process an ordinary news-reel camera using special film is used. The scene is shot by the news-reel camera, and as fast as the film is shot it passes into a developer, fixing bath, and is washed, and partially dried all in less than one minute. Then this partly dry film is televised by a telecine apparatus and transmitted over the air.

At the receiver the ordinary television picture, about five by seven inches, is taken on special film and the same quick developing-fixing-washing process is repeated. This partly dried film is projected in a motion picture theater in the regular way.

SUN ENGINE AT THE SMITHSONIAN INSTITUTION

SUN power will be translated into steam engine power in the near future at the Smithsonian Institution. Dr. Charles G. Abbot, the secretary, is now engaged in putting the finishing touches on an apparatus in which 36 square feet of aluminum mirror surface will capture enough of the poured-out energy of the world's central heating plant to run a one-half horse-power engine.

Dr. Abbot's new apparatus represents an improving evolution from earlier experimental models. Every part has been carefully planned to achieve a higher thermal efficiency than has ever been attained with solar boilers and other types of sun-heating apparatus.

The initial capture of the sun's rays is effected by means of three trough-shaped mirrors that can be turned so that they will constantly face the sun. They are surfaced with a highly polished, non-tarnishing aluminum alloy. Instead of being flat, as were most of the mirrors used by earlier experimenters, they are carefully figured to the same type of curve as that used in the great reflecting telescopes in the west, so that their focus is far more accurate and they therefore utilize a much larger percentage of the sun's rays. Their total reflecting area is 36 square feet.

Each mirror will focus the sun's rays on a long, double-walled tube of pyrex glass. Between the two walls a high vacuum is maintained. This permits radiation to pass in freely, but reduces the loss from re-radiation to a very low figure.

The inner tube contains a specially compounded black heat-absorbing liquid, of very high boiling point. If it were left stationary in the tubes, it would be raised to a calculated temperature of 700 degrees Centigrade. But it is kept flowing slowly by means of small electric pumps, so that it passes its heat on to water in a boiler, and maintains a more moderate temperature—from 175 to 200 degrees Centigrade above that of the surrounding air. This heat of course converts the water in the boiler into steam, at about 175 pounds pressure, and the steam will be used to drive the small engine.

Dr. Abbot states that the efficiency of his "sun-fired" boiler will be about 15 per cent., which compares favorably with the efficiency of a coal- or oil-fired boiler—with the advantage that its fuel cost is zero.

HARDSHIP IN YOUTH PROLONGS LIFE OF CRUSTACEA

HARDSHIP in youth is a good thing—for some of the lower animals at least. Half-fed through their infancy, cladocera or water-fleas live longer and more vigorously after they have passed what is for them middle life, according to experiments made by Dr. Lester Ingle and Professor A. M. Banta, of Brown University.

Cladocera are not fleas, though they do live in the water. They are really crustacea—minute relatives of lobsters, crabs and crayfishes. They are particularly well adapted to biological experimentation, because they are perfectly content to live in bottles on laboratory shelves. Requiring very little room per individual, they can be studied in statistically significant numbers at very little expense.

"The essence of Dr. Ingle's results is that limitation in quantity of food keeps the cladocera in a youthful condition," Professor Banta said, "so that when they are well fed in later life, beginning at a time when most of

the animals have 'lived rapidly' on abundance of food and have already died, these previously semi-fed animals assume rapid rates of growth and reproduction. In a way, their active life is just beginning. They are still young animals.

"As judged by the effects upon longevity, the most favorable period for the 'abundant life' is not during the earlier part of life, but at a later period when possibly the body of the organism is better able to withstand the effects of a fairly rapid dissipation of vital energy," Dr. Ingle said. "Suffice it to say that any and all the functions of the body, because of their utilization of vital energy, are factors in determining the life-span.

"The prolongation of the period of youth is perhaps after all not merely a vague dream, but quite possibly may have a basis for realization in temperate living, resulting in the moderate dissipation of vital energy."

ITEMS

LARGE enough to subject a human being to bombardment by neutrons, a new "atom smasher" or cyclotron is under construction at the radiation laboratory of the University of California, where Dr. Ernest O. Lawrence invented this powerful instrument and where he and his associates are continuing its use. Neutrons are more effective than x-rays in killing animal tumors, it was shown by animal experiments by Dr. John H. Lawrence, of the Yale School of Medicine, working with his brother at Berkeley. It is therefore possible that medicine is on the verge of applying a new weapon to human cancer. The electromagnet for the new cyclotron will measure 15 by 20 feet and weigh over 200 tons. It will be capable of producing 15 million electron volt energy particles. A small model of the electromagnet is now being tested in the laboratory under the direction of Dr. E. O. Lawrence.

ABSOLUTE identification of silicon in the lungs of supposed victims of silicosis, the dust disease now being intensely combated after the national attention focussed on the Gauley Bridge, W. Va., situation, is possible through use of the spectroscope, Miss Mary E. Warga, of the Mellon Institute of Industrial Research, University of Pittsburgh, announced to the conference on spectroscopy at the Massachusetts Institute of Techonolgy. By breaking up light from the suspected material by means of a prism, the chemical elements contained can be detected from the rainbow produced. In the case of suspected silicotic lungs, amounts of silicon as minute as one or two parts per thousand are positively detected by the spectroscope whereas usual chemical methods of detecting silica in such small amounts are difficult and time-taking. Miss Warga has also turned the spectroscope to practical use in detecting glass impurities, dust composition, coal ingredients, tin impurities and the cause of stains on cloth.

SUNLIGHT is a better and more permanent preservative of a commonly used tonic, syrup of ferrous iodide, than the chemicals ordinarily employed to keep the medicine, it appears from the report of Professor H. V. Arny and his associate, Dr. W. C. Mende, of Columbia University. Syrup of ferrous iodide when freshly prepared is "of an attractive green color," but when allowed to stand in a dark place or in diffused light for a few weeks it turns brown. This is due to the liberation of free iodine. "Such darkened syrup of ferrous iodide is dangerously irritating when taken internally and must not be dispensed by the pharmacist in such shape. Old time apothecaries found that the brown syrup returned to its original green color by the simple expedient of exposing it for a few hours to direct sunlight." Since 1876 chemical preservatives have been added to the syrup, but with little effect. The best of them kept the syrup green for only six months. Turning back to the notion of the old-time apothecaries, Dr. Arny again tried the effect of sunlight. He found that by keeping the syrup alternately in the sun and in the dark, making about five or six exposures to sunlight, he finally obtained a syrup of ferrous iodide which had a permanent green color.

A GAP between historic Indians and the vanished Moundbuilders may be closed by a clay figure in human form found in east central Louisiana. The hollow figure, decorated with animal patterns and a feathered robe, was found by Mrs. U. B. Evans, of Alexandria, La., an enthusiastic student of local archeology, and sent to Frank M. Setzler, curator of anthropology at the Smithsonian Institution. The image had been broken into six pieces, which, however, can be fitted together. The Indians inhabiting this region when the Spaniards, under De Soto, first entered the land were of the Caddo tribe. The newfound effigy appears to be a link between a prehistoric Caddo culture and a Moundbuilder culture known as Southern Hopewell, discovered in the same region. This in turn links with other Moundbuilder cultures in the South and with the highly developed Northern Hopewell culture of the Ohio Valley.

IT is now possible for the chemist to sort out molecules by using cellulose membrane of the kind employed to wrap cigarettes. How the "holes" in transparent cigarette wrapping material can be varied in size to allow such sorting was described by Professor James W. McBain and Dr. R. F. Stuewer, of Stanford University, before the concluding sessions of the Thirteenth Colloid Symposium of the American Chemical Society at St. Louis. "The holes may be adjusted smaller and smaller so that it is possible to put a solution of sugar or of salt or milk through and get only pure water." Application of the molecule sorting, it was indicated, is in finding out how far certain molecules in a solution exist independently of one another, or whether some are in chemical combination.

THE little color-changing lizards they call chameleons in Florida do not depend on their nerves to control their shifts in hue, but on the secretion of one part of the pituitary gland, a tiny organ situated close to the brain. This is indicated by recent researches of Dr. L. H. Kleinholz, of Harvard University. Dr. Kleinholz used several approaches to the problem. He found that cutting nerves did not affect the lizard's color-changing ability, but that removal of the pituitary gland left them unchangingly green. But injection of extracts of the gland, from other animal sources, at least temporarily restored the color responses. Dr. Kleinholz reports his results in some detail in the *Proceedings* of the National Academy of Sciences.

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW COSMIC RAY DEVICE AT THE UNIVERSITY OF CHICAGO

MORE powerful than any other similar apparatus in the world is the new cosmic ray equipment now nearing completion in the laboratory of Professor Arthur H. Compton, of the University of Chicago.

The heart of the device—a Wilson cloud chamber—is a giant 12-ton magnet whose strong field will bend cosmic rays and the atomic electrified débris so that their energies can be calculated. The magnetic field generated by the new magnet will be 40,000 times as powerful as that of the earth. It was designed by Professor Compton and his research associate, Haydon Jones.

Professor Compton states that the equipment will be used in a new series of experiments by which it is hoped further data can be obtained on high energy particles to see if the known laws of electricity apply to them.

As cosmic rays pass through the moist gas of the Wilson cloud chamber in the field of the magnet, they will leave a fog trail which is automatically photographed. Professor Compton estimates that there should be one cosmic ray entering each second and about one out of fifteen will be moving in the proper direction for photographing.

The magnetic field will bend the paths of the cosmic rays. Very high energy particles are less susceptible to deflection than are those of lesser energy, in somewhat the way that a baseball is harder to curve than is a ping-pong ball. Because the magnetic field will curve the tracks of the paths of particles of high energy to a less extent than it will those of low energy, it will be possible to judge the energy and determine if the particles are positively or negatively charged.

Previous experiments have measured energies up to 20 billion volts, but Professor Compton hopes to extend the measurement with his magnet to energies of 40 billion volts.

RADIO DATA DURING THE RECENT SOLAR ECLIPSE

HOPES that radio observations of the recent eclipse of the sun on June 19 in Siberia would be highly valuable were dimmed as the results of experiments made by members of the National Bureau of Standards were made known. Although few people realized it, a great magnetic storm struck the world just before and during the eclipse.

Despite general cloudiness and other unfavorable weather conditions, which ruined the visual and photographic observations of many eclipse expeditions from the United States and other nations, it was generally supposed that the radio observations would be successful.

There was world-wide cooperation on the radio tests on the recent eclipse. While scientists on the eclipse path were taking their observations of the reflections of radio signals from the ionizing layers miles above the earth's surface, S. S. Kirby, T. R. Gilliland, N. Smith and S. E. Reymer, investigators at Washington, took similar measurements which were to establish the normal pattern of the world's radio "roof" half way round the world. Thus, it was hoped, the effect on the layers of the moon's shadow due to the eclipse could better be ascertained.

What decreases the hopes that the eclipse radio observations will be of value is the discovery that on the two days preceding the eclipse, the eclipse day itself and the following day, the ionizing layers indicated a severe magnetic storm which made the whole world picture a greatly abnormal one. Even if the actual observations in the eclipse zone are different from the usual pattern it will be difficult to estimate just how much of the abnormality was due to the solar eclipse and how much was due to the known magnetic storm.

The National Bureau of Standards observations, reported in the *Physical Review*, mark a new step in what should become standard practice in future eclipse studies with radio.

While the effect of the sun's eclipse on the reflecting layers has been observed before in the actual eclipse zone, there has previously been no attempt to learn what were the normal world-wide conditions and to use this knowledge as a check against the eclipse readings.

STANDARD WHITE LIGHT

THE production of a standard white light or a "standard daylight" is one of the prime needs of investigators who work with color, whose problems are often not unrelated to those of the man who buys a tie and a shirt to match in a department store only to find they clash violently in broad daylight.

A method, by which scientists simply by choosing the thickness of a special color filter, or colored coverglass, can convert any artificial light into standard daylight, has been developed by Dr. H. P. Gage, chief of the Corning Glass Works optical division.

The method, expressed in a mathematical formula, for the specifications for glass filters, is far simpler than any method used heretofore for standardizing light. In fact, it reduces the computations of the daylight-correcting filters sufficiently so that the results can be shown on an 8×10 chart accurately enough for all engineering purposes.

The point is that the color of an object depends not only on the object itself but on the light in which it is viewed. Thus bright red letters on a white paper seen in a blue light, appear black, but when observed in red light disappear entirely. Hence the need for a standard light, not so much for viewing objects, as for measuring their color, a field in which scientists are working to set up accurate specifications. This requires a standard, artificial daylight which will be constant and available at all times of night or day and under all outside weather conditions, and in any part of a building. This has been available for some time by using a high efficiency tungsten lamp, modified by a glass color filter, but its satis-

factory use has been hindered by the complexities of getting the correct filter.

With Dr. Gage's formula, which was presented to the Massachusetts Institute of Technology color conference, it is necessary only to know a few facts about the light source to be standardized, which when compared with the data for average natural daylight, gives the thickness of the glass filter which will transform the light source into daylight.

THE HEALING EFFECTS OF UREA

UREA, ordinarily considered a waste product of the body, is good medicine for slow-healing wounds. Its successful use on patients by physicians all over the country is reported by Dr. William Robinson, entomologist of the U. S. Department of Agriculture, in the current issue of *The American Journal of Surgery*.

A two per cent. solution of urea, made with sterile water, is applied directly to the wound. Relief of pain and rapid healing has followed in cases of varicose and diabetic ulcers, carbuncles, extensive infected burns, mouth infections, osteomyelitis and certain skin infections. No ill results have so far been reported from this use of urea, and its low cost, about fifty cents a pound, makes its extensive use quite practicable. The solution is bland, colorless and odorless, and as used medicinally comes from a manufactured product having no connection with body wastes.

The urea solution apparently achieves its effect by stimulating a "vigorous growth" of new tissue with abundant blood supply. It does not have any direct germ-killing effect on the organisms involved in chronic, pus-forming wounds. Its cleansing effect on these wounds is produced indirectly through the stimulation of the growth of new healthy tissue.

The healing effect of urea was discovered through investigations of maggots made by Dr. Robinson. A wartime discovery by the late Dr. William S. Baer, American surgeon, showed that these tiny creatures, loathsome as they might seem when crawling around in an open wound, had the power to clean up the wound and stimulate healing of the tissues. Dr. Baer died before he could find why the maggots in many cases surpassed other means of healing wounds. Government investigators continued his work, breeding clean, germ-free maggots and studying them. The first clue to their healing power was the discovery that they produced allantoin, which in itself is a healing agent.

Further study showed that this was not the only substance with healing power present in maggot excretions. The chemical structure of allantoin suggested the possibility that urea, which can be formed by adding hydrogen to one of the chemical groups that make up allantoin, might be the active agent with which maggots were healing wounds. Whether or not this is the case, the suggestion led to a trial of urea itself, with the success reported by Dr. Robinson.

Urea can be made by combining ammonia with carbon dioxide. It occurs in human tissues and also is of common occurrence in plants. Its name comes from the fact that it was first discovered in one of the body's waste products. If, as Dr. Robinson points out, it had first been discovered in spinach, where it also occurs, its name would probably seem more pleasant.

ITEMS

SOVIET aviators unofficially broke, late last month, the world's long-distance airplane record with a non-stop flight of 5,825 miles. Remaining aloft nearly 56 and one half hours, pilots V. P. Chkalov, G. F. Baydukov and navigator A. V. Belyakov took their heavily-laden, single-motored ANT-25 plane under adverse weather conditions from Moscow to the tiny island of Udd on the Siberian Coast just west of Nikolaevsk-on-Amur. Deliberately they flew out over the Barentz Sea and the Arctic Ocean for more than half of the flight. While the distance covered exceeds the record of 5,657 miles made by the French aviators M. Rossi and P. Codos in 1933, it can not be entered as official because it was not in a straight line. Take-off and landing points alone are considered in the records. But the Soviet pilots were seeking knowledge of Arctic conditions which is more important than records.

ON August 29 the National Bureau of Standards will start a two-week test broadcast of sending out continuously, night and day, the four hundred cycle note that is A on the piano. The broadcast will be held at the request of musical organizations that need a really accurate and truly-pitch A. Musical instrument makers, piano tuners and others who have need for an accurate standard of pitch are asked to write the radio section of the bureau for further details and comment on the new service. The only time, day or night, when the "A" will not be broadcast will be Tuesday, Wednesday and Friday from noon to 3:30 P. M., E.S.T. While the older receiving sets may not pick up the signals the newer sets and the "short wave" receivers will. Transmission will be on 5,000, 10,000 and 15,000 kilocycles per second.

NATURE, not man, preserved New Guinea's mysterious group of human "mummies," found sitting knees-to-chin in a long cave in the Morabe goldfields district. With this verdict, two British investigators have apparently upset the earlier pronouncement on discovery of the mummies, that New Guinea natives once knew how to mummify bodies as the Egyptians did, and perhaps learned the art from distant Egypt itself. The mummies appear to be dried-up, not embalmed, according to E. L. Gordon-Thomas, in an article in the scientific journal, *Man*. That conditions in the limestone cave, high above the sea, served to dehydrate the bodies, is the supporting view of Dr. E. T. Brennan, principal medical officer of New Zealand. Finding the light-skinned corpses—over 60 of them—may shed light on problems of New Guinea anthropology. The ancient chapters of New Guinea's habitation by man have been little probed. Present-day natives can not explain the burial customs that mummies of the cave tomb represent, nor can the natives show how people would handle and use the huge stone pestels and mortars which have been found in this area.

SCIENCE NEWS

Science Service, Washington, D. C.

FOUNDATION FOR THE 200-INCH TELESCOPE

WITH 50 workmen prepared to pour the concrete for the foundation of the world's largest 200-inch telescope on Mount Palomar, California, which is 6,126 feet high, an ultra short-wave experimental radio station has been installed to facilitate instant communication on construction progress with scientists in charge at the California Institute of Technology in Pasadena, 100 miles away.

Operating on a wave-length of seven meters, the radio station, having call letters of W6XKY, is in direct communications with station W6XKX on the roof of the Astrophysical Building at Pasadena. Because of the directional effect of such short waves the antennae of both stations are focussed on each other. The stations are serving the double purpose of furnishing heads of the project with direct communication facilities and of permitting Caltech and Bell Telephone investigators to experiment with such short waves.

Wave-lengths under 10 meters have been considered of little commercial value, and these stations, in addition to furnishing communications, also are supplying data on the behavior and nature of ultra short waves, information heretofore unavailable. Operating on 7 meters, the stations are unable to tune into any others.

As a result of this radio installation, Captain C. S. McDowell, supervising engineer for the telescope, stationed in Pasadena, can get into instant touch with supervisors on the mountain regarding construction details.

In addition to construction of the 200-inch telescope foundation, workers are completing the machine shop and power equipment structure in which two generators, driven by Diesel engines, will be installed to furnish power to the village at the site.

Experts are installing the Schmidt telescope in a dome completed some time ago. Observations with this 18-inch reflector, an auxiliary "eye" to the 200-inch mirror, will furnish an index on seeing qualities by the time the giant telescope is completed and ready for use.

A 1,000,000-gallon water reservoir has been built, as have two Diesel oil storage tanks, in addition to bungalows to house workmen and scientists.

The contract for fabrication of the 200-inch telescope tube has been awarded to the Westinghouse Company in Philadelphia. This part of the telescope, including a giant yoke, will have a weight of approximately 900,000 pounds. Delivery of the tube won't start until the dome is completed. The dome itself won't be started until after a surfaced high-gear road is laid down to the site, probably next spring.

No other major construction is planned for the remainder of 1936. A skeleton crew will be maintained during the winter, laying water mains, installing transmission cables, and doing additional work on the 200-inch instrument foundation which will be separate from the foundation for the dome to reduce vibration and shock on the instrument.

SPECTROSCOPIC ANALYSIS OF HEMOGLOBIN

THE first complete analysis of the spectrum of hemoglobin, the complex blood pigment that carries life-giving oxygen from the lungs to the rest of the body, was reported to the spectroscopy conference at the Massachusetts Institute of Technology, on July 21, by Dr. David L. Drabkin, of the University of Pennsylvania.

His investigation, made with the spectroscope, reveals much unexpected information concerning the body's oxygen carrier, whose importance is realized, but about which much remains to be learned. The research is expected to afford a better understanding of the nature of the union of hemoglobin and oxygen or other gases, and of the energy changes involved in this union.

Why nature has chosen a colored pigment to carry oxygen, why hemoglobin, with its huge molecular weight of 68,000, is used to carry oxygen whose molecular weight of only 32 seems insignificant in comparison, how the globin is attached to the iron-porphyrin groups are other problems Dr. Drabkin's research may solve by its analysis of the whole living blood. On the answers may hang some of the most important and valuable discoveries medicine has made concerning the human body in recent years.

Dr. Drabkin used the spectroscope in his investigation to analyze the light given off by hemoglobin when he hurled tiny electrons into the very atoms of which the plasma is composed.

The most significant fact disclosed was the unexpected one that the tell-tale rainbows of light, by which substances are identified, were regularly spaced along the spectrum, and that the complete picture of hemoglobin represented the additive result of the individual characteristic bands, whose structure could be expressed mathematically.

This regular spacing, previously demonstrated only with relatively simple chemical substances, enabled Dr. Drabkin to derive a formula which greatly simplifies the complicated spectroscopic picture of the hemoglobin spectrum.

RHYTHM AND THYROID FEEDING

DR. N. KLEITMAN and Dr. S. Titelbaum, of the University of Chicago, taught their dogs to show they had a sense of rhythm by lifting the same foot every time they heard a metronome beating one hundred times a minute. Each time the metronome was operated at this speed the dogs, placed in a small wooden enclosure for the duration of the lesson, received a small electric shock in one hind leg, until finally they learned to avoid the shock by raising the leg as soon as the metronome signal was heard. Since their legs were not shocked when the metronome was run at other than the one-hundred-a-minute beat, the dogs learned to respond only to this. When their training was complete they underwent a three-day final examination. The metronome was run at the correct rate several times during each day, to be sure that the dogs

would respond properly. Five experimenters, each working independently with his own dog, carried on the work.

Now the dogs were tested with the metronome running at various speeds, the one to which they had been trained to respond, and others as close to this as they could distinguish. Careful records of just how accurate was each dog's sense of rhythm were kept.

Then the dogs were fed thyroid gland material. They showed they had a better sense of rhythm on this medication by not responding as often as before to beats close to the one-hundred-a-minute one to which they had been trained. Furthermore, they moved their legs more energetically in response to the correct beat while on thyroid.

Two of the animals had a superior rhythm sense, and made especially good grades in their tests even when not given any thyroid. These showed no improvement on administration of thyroid. Normal animals grew fatigued toward the end of each experimental period of 5 to 10 days and got poorer grades at the close of each one. But the thyroid dogs appeared only to hit their strides as each trial progressed, and made better showings towards its end than at the beginning.

The object of the study was not to find out about dogs' rhythm but to learn whether or not thyroid affects conditioned reflexes, such as that set up in the dogs, and differentiating ability, such as enabled the dogs to distinguish between the different rhythms.

The study just reported is part of a study of sleep. It is hoped to learn what part conditioned reflexes and differentiation may play in producing "internal inhibition" and sleep. For a substance is needed which will control differentiation, increasing or decreasing it at will, and thyroid extract appeared as a possibility.

INJURIES TO ATHLETES

DR. MARCUS H. HOBART, who, for twelve years, has been handling athletic injuries at Northwestern University, finds that on athletic fields more injuries occur to the knee than to any other part of the player's anatomy. He presents in the *Journal* of the American Medical Association a review of his experiences, with detailed statistics on the injuries that have occurred in that university in the last five years.

Football, as might be expected, has the longest casualty list of any sport. Dr. Hobart thinks this only natural for "probably five or six times as many students play football as any other sport." Next to football in frequency of injuries comes wrestling, and after that basketball, baseball, track, swimming, water polo and boxing. Other sports are too safe to merit consideration.

The knee takes the brunt of the punishment for several reasons. Its position is exposed, it can be affected by both direct and indirect force, and since the ankles are well protected and do not give way, the strain is transmitted to the knee. Dr. Hobart thinks it might be better not to strap players' ankles so tightly.

Next in frequency to knee injuries come those to the fingers and toes, ankles, shoulders, nose, face, elbows, back and legs and feet.

Athletic injuries are either in a class by themselves or in a class with war injuries, the idea being to return athlete or soldier to team or trenches quickly and full recovered. So that a student may be returned to practice or play only when it will do him no damage, Dr. Hobart states that a physician should be in full charge of the physical side of the team, as the head coach is in charge of the athletic side.

Fractured bones, in Dr. Hobart's athlete cases, are almost always put in a cast rather than a splint, as the cast can not be easily removed. The general rule, he says, is to use a cast for fractures in children, athletes, idiots and doctors. Sprains are the most common injuries in athletics, followed by contusions and concussions, fractures, cartilage injuries, lacerations and dislocations.

CHILDHOOD ACCIDENTS

MORE than twice as many children under fifteen years are killed by accidents as by three common communicable diseases, measles, scarlet fever and diphtheria. This fact emerges in a study of fatal childhood accidents which has been undertaken by the U. S. Public Health Service. The first section of the study, relating to automobile accidents, has been reported by William M. Gafafer, senior statistician of the Federal Health Service.

For children under one year of age mechanical suffocation leads the list of fatal accidents. At one and two years burns caused most fatal accidents. Automobile accidents and burns lead at three years. At four years and from then up to fifteen years, automobile accidents rank first as cause of accidental deaths and also outnumber deaths from the three diseases, measles, scarlet fever and diphtheria. The study was limited to the year 1930, the most recent year for which accurate population enumerations exist.

Mr. Gafafer divided the country into three geographical regions, Northeastern, North Central, Southeastern and Western, and reviewed the fatality figures region by region.

The Northeastern region had most childhood automobile deaths per hundred thousand children. Next greatest number was found in the Western region. Then followed the North Central and finally the Southeastern with fewest deaths per hundred thousand children. This order was changed when the regions were rated according to deaths per hundred thousand registered automobiles or per 50 million gallons of gasoline consumed. Using these measures of mortality, the Northeastern region still led with most deaths, followed by the Southeastern, the North Central and finally the Western regions. The reason for the change in order, Mr. Gafafer explains, is that the Western region has more automobiles in relation to the number of children.

ITEMS

THE Crop Reporting Board of the Bureau of Agricultural Economics released a report on August 10, according to which corn production is estimated to be only 46 per cent. normal and the crop is the worst since 1901. Spring wheat is only 32.8 per cent. normal and with the exception of 1934 is the worst on record. Oats are 55 per cent. normal and of all the edible grains only rice, at 86 per cent., is anything like normal yield. The potato crop, at 59.8 per cent. normal, is the worst on record since

1863. Cotton, unlike most crops, has had favorable weather during July, and the yields are expected to be above average in all states except in Virginia and the Carolinas.

SUCCESSFUL observation of the Perseid meteors on the nights of August 11 and 12 and August 12 and 13 has been reported by Professor C. P. Olivier, of the Flower Observatory of the University of Pennsylvania. Observing at Shadwell, Va., he reports that cloudiness and moonlight on the first night of the Perseid shower made the meteor watch difficult. Forty-seven meteors were seen, however. Thirty-four of these were in the Perseid group. The next night observing conditions were much better and a total of 72 meteor streaks was seen. Fifty of these were Perseid in origin. One especially fine sporadic meteor crossed nearly half the sky, disappearing and reappearing as it neared the end of its path. One brilliant Perseid meteor left a flaming train which lasted 10 seconds. Other bright Perseids, mostly red in color, left sparks as well as trains. The average Perseid meteor was yellow in color, as usual, and nearly all had trains of brief duration.

REPORTS received by the U. S. Public Health Service show an increase in infantile paralysis cases, the total number for the country reaching 142 during the week of August 1. The increase is chiefly due to sporadic cases in various parts of the country, rather than to an increase of the outbreak in the Southern states. These cases are seen as part of the usual seasonal rise and are not considered a result of the earlier outbreak in the South. Of the Southern states chiefly affected, Tennessee had an increase, with 26 cases for the week, but Alabama with 29, and Mississippi with 5, showed decreases over the previous week. California reported 16 cases, Illinois 12 and New York 6, with from 3 to 6 each reported in Minnesota, North Dakota and Nebraska.

DETAILS of a mild case of bubonic plague occurring in an eleven-year-old lad living in Monterey County, Calif., have been received at the U. S. Public Health Service from Dr. Harlin L. Wynns, of the California State Health Department. This is the third human case of plague reported in the United States thus far this year, one of the others also occurring in California, while the third was near Beaver, Utah. Plague has been ever-present in the rodent population in California since an outbreak of human plague occurred in San Francisco early in this century. The disease is transmitted from rats or other rodents by fleas. Plague-infected ground-squirrels have been found as far east as Montana and Utah and these animals are a potential source of danger.

LITTLE mentioned among the drought hazards to cattle is the possibility of the animals eating the hardy Sudan grass, cane or any kind of grain sorghum which, although stunted in growth by the dry weather, will stay green long after the normal feed grasses have withered. The Department of Agriculture reports that in eating these plants live stock may consume a deadly dose of hydrocyanic or prussic acid, present in the plants.

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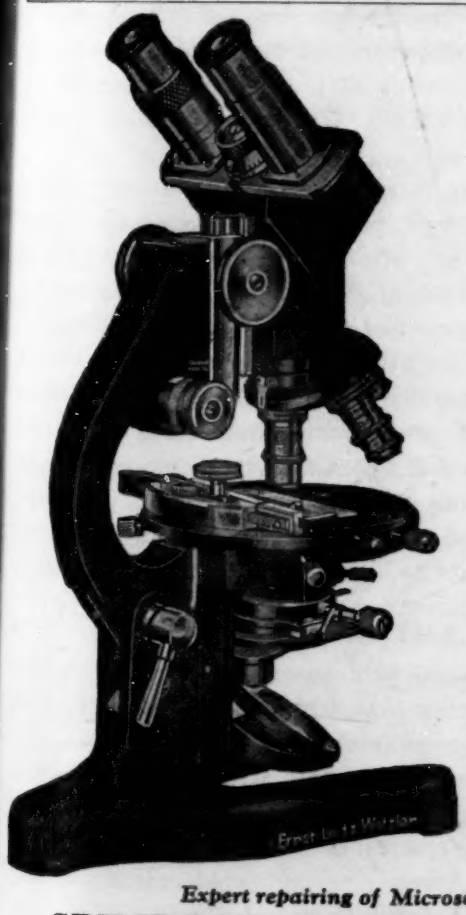

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SCIENCE NEWS

Science Service, Washington, D. C.

NEW TYPES OF ATOM DESTRUCTION

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COSMIC rays, already one of the most baffling mysteries of the world of science, are even more complex in their behavior than hitherto imagined. New ways, heretofore unreported, in which the penetrating rays can destroy atom nuclei by impact have been discovered by Drs. Carl D. Anderson and Seth H. Neddermeyer, of the California Institute of Technology. Dr. Anderson is well known for his discovery of the famous "positron," one of the fundamental particles from which all matter appears to be composed.

In a report to the American Physical Society through its journal, *The Physical Review*, the first full description of the recent high altitude experiments at Pike's Peak, Colorado, are as follows: (1) That the bundles of cosmic ray energy, known as photons, can disintegrate heavy atoms such as lead; (2) that light and tiny electrons can smash into the nuclear heart of atoms and occasionally break them up and make them eject massive particles; (3) that some of the disintegrations seem to be produced by the non-charged and piercing particles known as neutrons occurring as secondary radiation in the cosmic rays.

In the experiments tons of apparatus were moved from Pasadena by truck across deserts and up Pike's Peak in order that the identical equipment could be used at the two locations to give a most accurate comparison of results.

In an intensive program of research on the mountain top Dr. Anderson and Dr. Neddermeyer accomplished what was virtually a whole year of investigation in a few weeks. Thousands of photographs were taken with Wilson cloud chamber apparatus which showed cosmic rays destroying atoms and molecules. Use of the mountain top was prompted by the knowledge that much of the earth's atmosphere would be below the instruments so that the cosmic rays observed would be more powerful than in the Pasadena laboratory near sea-level.

While other investigators have taken measurements of cosmic rays at even greater heights, the Anderson-Neddermeyer research was the first in which actual photographs of the atomic breakdown were obtained.

THE MASS OF THE STARS

(*Copyright, 1936, by Science Service*)

NEW scientific evidence that the universe is expanding, and a stilling of the fears of those peoples who worry because the sun and the stars are "quickly" destroying themselves by turning their mass into the radiation they emit, is presented in the forthcoming September issue of *The Astrophysical Journal*.

M. Henri Mineur, astronomer at the Observatory of Paris, reports calculations showing that the stars of the Milky Way, despite their age of tens of thousands of millions of years, have only radiated away about one hundredth of their mass.

Thus if one takes M. Mineur's estimate that Milky Way stars are from ten to twenty billion years old, the apparent age of the universe, before all the mass is radiated away, would be about a trillion years. Compared to the life of a man who lives to be 75 years old the star galaxy which contains the earth and the Milky Way is only a baby, about nine months old, and cutting its first teeth.

Significant to astronomers is M. Mineur's calculations showing that the stars in the Milky Way must have been formed in the beginning with almost the same mass which they have to-day. Present-held theories of star evolution, therefore, must go by the board if the French astronomer's calculations and the observations on which they are based are correct.

M. Mineur says: "The upper limit we have found for the age of the stars is so small that, in so brief a time, the great majority of the stars can not have lost more than a hundredth part of their mass. We must therefore believe that the stars were formed with nearly the same masses as they have now, and that the differences in temperature and spectral type actually observed are due to the fact that the stellar masses were already different at the time of their formation.

"An evolution of the stars such as has been generally accepted is, then, impossible. Our result is, however, in perfect agreement with the theory of the expansion of the universe. G. Lemaître has suggested a hypothesis for the formation of the extragalactic nebulae based upon his theory of the expansion of the universe, according to which the age of the Milky Way would not exceed ten thousand million years."

The G. Lemaître referred to is the well-known Abbe Lemaître, Belgian astronomer who has frequently visited America and has been attached to the faculty of the Massachusetts Institute of Technology and also on the staff at Mount Wilson Observatory.

Abbe Lemaître's hypothesis on the expansion of the universe is now generally accepted among astronomers. It postulates that at some distant time in the past there was a gigantic explosion which sent the component parts of the universe into an expansion which is still going on. The various stars and galaxies are rushing away from one another with velocities as high as 15,000 miles per second.

PLANT GENETICS

DR. GEORGE H. SHULL, professor of botany and genetics at Princeton University, has advanced two steps further in his study of the mechanics of heredity with the location and separation of two new strains of Lamarck's evening primrose.

One variety of the species, known as acuminata because of its long pointed leaves, first appeared recently in the experimental field of forty thousand plants. The other strain, called pollicata after the solid stem it grows between the ovary and style, appeared in 1932 and 1935,

but was not proved to be a separate and distinct strain until this summer.

The new plant is striking in that its long leaves almost completely lack the usual crinkledness of the primrose. Its characteristics are recessive, as is demonstrated by the fact that the acuminata appeared in only six out of 25 plants, indicating a one to four ratio for these characteristics in the offspring of the hybrids.

The pollicata first appeared for Dr. Shull in 1932 when it occurred as a gene mutation in pure bred material of Lamarck's evening primrose. Last year it appeared anew in another strain of this species, independent of its previous origin in 1932.

This indicated that the pollicata might be a latent characteristic of all primroses, rather than a new development, so Dr. Shull crossed this plant with all 25 different strains of his evening primrose.

The pollicata has now reappeared only in the offspring of the family in which it appeared last summer. None of the crosses with the other plants produced this solid-stemmed flower with "clubby" stigmas, proving that this is now another new strain of the primrose.

It is entirely possible, Dr. Shull explained, that the pollicata might be developed independently in any other experimental work in primroses, but to date this is the only example of this solid-stemmed variety, which is not even found among the wild relatives of the primrose.

The dry weather of the past few weeks has stunned the size of Dr. Shull's plants, but has not hindered the effectiveness of the bloom. The total number of plants growing this year is nearly three thousand larger than the number Dr. Shull has been able to handle any one year at a time since he began this experimental work in 1905.

A NEW-FOUND DIET FACTOR

A NEW factor in the vegetable oils fed to baby chicks has been found by Drs. Marrianne Goettsch and Alwin M. Pappenheimer, of the College of Physicians and Surgeons, of Columbia University. When the new diet factor is lacking the chicks will literally lose their brains.

They fed pedigreed chicks on a diet which contained all the nutrients and vitamins known to be necessary, yet these birds persisted in ailing. After a short period of normal growth, they would begin to have nervous tremors, to pull in their heads after the manner of sick chicks, and to lose the power of coordinating their movements. Finally they would sink into a stupor which would end in death.

Autopsies all showed the same results. Parts of the brain had become swollen, soft and wet; appearing either pale or stippled with the blood of many tiny hemorrhages. As the disease progressed, the dead areas became more definite. Parts of the brain were actually being killed as, for some reason, the tiny blood-vessels leading to them were blocked, and blood was prevented from reaching the diseased parts.

Placed on various diets, the chicks still failed to become healthy, until to their ration was added a vegetable oil. The disease, which appeared only in chicks whose brains were actively growing, was prevented by the addition of corn, cottonseed, peanut or soybean oils and even the hard, artificially made "vegetable fats." Lard, however, actually seemed to favor the development of the trouble.

Other experimenters suggested that the condition was caused by the lack of the already known vitamin, B_4. But this is soluble in water, which the material in question is not. So it is probably a new vitamin.

So delicate is the new food-requirement that only by treating the petroleum ether used to extract it from the oil with sulfuric acid for a number of hours could it be brought to a pure enough stage to be used. When this purification process was not carried on, the minute impurities of the ether destroyed the effectiveness of the material.

INDUSTRIAL EFFICIENCY AND SOCIAL ENVIRONMENT

THE effect of social conditions on the work of a group of five girls assembling telephone relays at the Hawthorne plant of the Western Electric Company, and another group of workers, have been studied by Dr. Lawrence J. Henderson, of Harvard University, and Dr. Elton Mayo, of the Harvard Business School. The results were reported at the opening session of a symposium at the Harvard School of Public Health.

The symposium is devoted to consideration of the effect of the environment on man and is one of the conferences on arts and sciences being held in celebration of the Harvard University Tercentenary.

Most of the symposium is given over to discussion of physical factors of the environment, such as temperature and humidity of the air and air-conditioning; poisonous gases and injurious dusts; air-borne disease, and the germs of hayfever-causing pollen of the air. These factors affect health, comfort and consequently efficiency. Social factors that are hard to measure and may even be overlooked are nevertheless a very real part of man's environment and have a measurable effect on his efficiency as a worker, it appears from the experiments reported by Drs. Henderson and Mayo.

The five girls, all experienced and expert assemblers, who took part in one of the experiments were observed over a period of five years. They worked in a special room; they were allowed to converse freely; their output was recorded minute by minute and day by day; their conversations, mutual relations, home situations and leisure activities were all noted. The study was made with the consent and cooperation of the girls.

Particularly interesting were the wave-like irregularities observed in output. These waves lasted sometimes for months, sometimes only for a few minutes. They were not related to any change in physical circumstances, such as temperature or the worker's own physical state. The speed of work, however, did vary markedly with changes in the girls' feelings towards each other, towards their supervisors and towards the group as a whole.

A change in seating arrangements, which separated two friends and generally disturbed the neighborly relations of the group, lowered the output. When one of the workers, after several years, left the company and was

replaced by another girl, even though the latter had a friend in the group, a disturbance in the group's tone was noted for three months. Drop in output was noted at the beginning of the economic depression. As the leader of the group put it, "We lost our pride." It was also noted that when one girl was dispirited and for this or some similar reason slowed down in her work, her neighbor or best friend also slowed. A reverse effect was noted between two girls who were unfriendly. When one worked fast, the other worked slowly and *vice versa*.

Another study of a group of men working in the general workroom of the same plant showed again how the social forces in the group affected the work output.

Drs. Henderson and Mayo caution administrators against too many and too rapid changes in work arrangements. These changes may be logically expected to increase efficiency, but if they upset the workers' social relations and work routines, they will decrease efficiency because they upset the worker's feeling about his work and the world he lives in.

PRE-SHRUNK PAINT

"PRE-SHRUNK" paint has become a reality. Contrived with the help of soybeans and tung nuts, this latest product of industrial research in new farm crops has two results. It has altered previous knowledge of how paint should be made and further bears promise of solving the problem of weathering in this commodity.

"Pre-shrunk" paint is another of those curious unforeseen accidental discoveries which give constant zest to the life of the research chemist. This one happened in the laboratory of a South Bend manufacturing plant where tung oil's possibilities as a "vehicle" for paint were under investigation.

For use in paint tung oil requires a delicate high temperature treatment. The process, however, is often marked by failure because if the heat goes too high the liquid will change to a solid within a matter of seconds. For thirty years chemists have known how to control that trouble so the tung oil can be used in varnish. But, until recently use of tung oil in paint has been limited.

How the trouble was overcome and pre-shrunk paint evolved was described by M. F. Taggert, director of research for the South Bend concern.

"After trying all practical mixtures of oil," Mr. Taggart stated, "we found that a mixture of 45 per cent. soybean oil with 55 per cent. tung oil was the best combination to prevent solidification in the high temperature treatment required to make the tung oil usable in paint.

"In one particular trial we started with 775 pounds of the oil mixture which is equivalent to 100 gallons. This was raised to the suitable temperature with no difficulty, but in measuring up we discovered that although our mixture still weighed 775 pounds we only had 97 gallons of the liquid. Somehow there had been a shrinkage of three gallons, this being indicated by an increase in specific gravity exactly equivalent to the seemingly missing portion.

"Inasmuch as raw oils shrink during weathering, this pre-shrinking of the soybean-tung oil combination contributes to a longer life of the paint."

This accidental discovery, Mr. Taggart continued, immediately caused the scrapping of all previous knowledge of how paint should be made. Another problem arose, however, involving the question of what type of pigments and in what proportion of those pigments the new oil combination would work best.

Using the new "vehicle" with its peculiar "pre-shrunk" property, the chemists then went to work on hundreds of paint formulae. One pigment at a time was at first used, then pairs of pigments, and so on through the gamut of available pigments until eventually the one formula was determined in which the "pre-shrunk" quality of the oil can be utilized to the best advantage.

ITEMS

DEATHS exceeded births in France during 1935, according to *La Science et la Vie*. Births during the year numbered 638,881, and there were 658,357 deaths—a morbidity excess of nearly 20,000. During 1934 births exceeded deaths by about 43,000. Unemployment and rising cost of living in France are blamed for the situation. At the same time Germany showed an excess of 480,000 births over deaths during 1935.

A MOTION picture entitled "Hay Fever" has been prepared at the Mayo Clinic as an aid to hay fever patients. The film, Dr. L. E. Prickman explained at a recent staff meeting, is intended to teach the patient "all the little details by which he can lessen the severity of his symptoms" and thus improve the results of desensitization treatment—details which the busy practitioner can not always find time to discuss with every patient.

CLOSE your eyes and let some one touch your arm. Now, can you point directly toward the spot touched without opening your eyes, or do you need to look at your arm first? Dr. Theodora Mead Abel, of the General Education Board, reports to the *American Journal of Psychology* that usually children do better with their eyes closed, but adults generally want to see. Individuals physically mature, but in the moron level of intelligence, are more like children than grown-ups in this respect.

BY measuring the water levels in the Great Lakes for the last century, it has been discovered that the great farming and grazing area in the North Central United States is near the bottom depth of what appears to be a 46-year snow and rainfall cycle that is associated with the variations in the radiation coming from the sun. Dr. Charles G. Abbot, secretary of the Smithsonian Institution and expert on the solar cycles of radiation, states that the droughts of 1934 and 1936 constitute striking evidence for the now-celebrated 23-year weather cycle which he first announced three years ago. The drainage areas of the North Central section have the local peculiarity of having their least precipitation at double this 23-year cycle.

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Chapter Headings

I. Structure and Physiology of Seed Plants

Coloration in Plants
Plant Cells
Leaves
Metabolism—Food Synthesis
Roots
Absorption of Water and Inorganic Salts
Stems
Growth and Movement
Flowers
Fruits, Seeds, and Seedlings
Metabolism—The Catabolic Phase. Digestion—Respiration—Fermentation

II. The Plant Groups

The Classification of Plants
Thallophyta—Algae
Thallophyta—Fungi
Bryophyta—Liverworts and Mosses
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SCIENCE NEWS

Science Service, Washington, D. C.

EXPOSURE TO SILICA DUST

By JANE STAFFORD

HOPE that the half a million workers in the United States who are exposed to silica dust in dangerous amounts may be saved from silicosis appears in the discussions of dust diseases at the Harvard School of Public Health. The effectiveness of dust control measures in preventing silicosis is seen in the experience of the South African gold mines as cited by Professor Philip Drinker, of Harvard.

"No new Rand miner who has entered the industry since August, 1923, has contracted silicosis," Professor Drinker quoted from a South African report covering a ten-and-one-half-year period. "These facts demonstrate that the engineering and medical measures which have been directed against silicosis have achieved a very significant degree of success."

In South Africa, and only there, it was realized at the outset, Professor Drinker said, that dustiness would not be controlled properly unless measured and recorded routinely. Discussing various methods that have been devised for measuring the amount of harmful silica dust, Professor Drinker said that a rapid method making use of a portable instrument was best for routine measurements.

The practical plant or mine manager wants an objective for his dust control, but unfortunately there are not and probably never will be exact figures to show a safe limit of silica particles in the air. Studies of the U. S. Public Health Service suggest some figures for dust standards. In the case of barre granite, a dustiness of ten to twenty million particles per cubic foot was found reasonably certain not to cause disability of the workers. In the anthracite coal mines, counts of 50 million per cubic foot, with five per cent. quartz in the coarse dust, seemed safe. Still another standard is desirable for the plant that handles dust of a kind that has not been proved a serious hazard to health. Scientists can not give the manager of such a plant any figures, but Professor Drinker suggests that he investigate one of the many plants that have reduced dustiness without waiting for their workers' health to be affected by the dusty atmosphere. Generally, the manager and workmen of the clean plant will uphold eloquently the advantages of dust control.

Once silicosis has developed, it is likely to progress, Dr. W. Irving Clark, physician to the Norton Company and assistant professor of industrial medicine at the Harvard School of Public Health, pointed out. The reason for this seems to be that in high concentrations silica is toxic and kills tissue. This progressive tendency of silicosis is a serious problem for industry. A worker, for example, may contract silicosis while working for one employer and may develop disabling symptoms many years later while working for another employer. If the work for the employer involved exposure to dust of an inert nature, which affects the lungs slightly as seen in x-ray pictures but does not disable the patient, the second employer may have difficulty in proving that the dust in his shop was not the cause of the disability.

Prevention is the only method of treating the lung diseases caused by dust, among which the most serious is silicosis. Dust must be eliminated from industry wherever possible, and when this is not possible the worker must use a protective device such as a respirator or a positive air pressure helmet. When examination shows the worker's lungs have become affected by the dust, it is best to keep him at work but in a non-dusty department. As shortness of breath increases, lighter work must be given him.

VITAMIN B MADE BY LABORATORY METHODS

ARTIFICIAL production by chemical methods of vitamin B_1, the beri-beri-preventing vitamin, has finally been achieved by Dr. R. R. Williams, of the Bell Telephone Laboratories, and Dr. J. K. Kline, of the Research Laboratories of Merck and Company. Collaborating in the research leading up to the vitamin synthesis, part of which was done at Columbia University and part at the laboratories of Merck and Company, were Professor H. T. Clarke, Dr. E. R. Buchman and R. E. Waterman and A. E. Ruehle.

The vitamin, it is claimed, can be produced much more cheaply by the synthetic process, difficult though it is, than by previously developed methods of extracting it from natural sources.

All higher plants synthesize vitamin B_1, but Dr. Williams and coworkers did not follow the plant method of manufacture in producing the vitamin in their laboratories. Instead they worked from simple chemical molecules, building them up step by step into the complicated molecule that is vitamin B_1. The synthetic product they achieved confirms the chemical picture of the vitamin molecule which Dr. Williams recently announced.

The synthesis is effected by combining 2 methyl 5 brom methyl 6 amino pyrimidine with 4 methyl 5 beta hydroxy ethyl thiazole. The former is somewhat related to the hypnotic Barbital; the latter is a pyridine-like sulfur containing substance more or less akin to certain of the agents used in accelerating the vulcanization of rubber and in the sensitization of photographic plates. Each of these, however, is a new substance and every atom must be in its proper place.

STUDIES OF HURRICANE WEATHER

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WHAT is believed to be the first organized attempt to record meteorological conditions in the upper atmosphere during violent tropical hurricanes over the Caribbean Sea and southern states will be undertaken shortly by investigators at the Massachusetts Institute of Technology. The storms are expected between the middle of August and late October.

The expedition is divided into two sections, one to

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operate in Cuba and the other in southern states in order to record the rapid changes in atmospheric conditions when the tropical storms curve inland from the Gulf of Mexico.

Delbar P. Keily and Douglas MacKiernan, Jr., will comprise the Cuba section. They will release only radio balloons, for instruments sent aloft here are not expected to be recovered. Christian Harmantas will operate in southern states releasing the smoked glass type balloons at Augusta, Ga., Montgomery, Ala., Jackson, Miss., and other southern points.

The equipment includes 80 sounding balloons and specially constructed meteorographs which the balloons will carry miles into the air to record temperature, atmospheric pressure and humidity. Thirty are equipped with tiny radio transmitters which will automatically send their readings to a base station at frequent intervals. The others will make their records on pieces of smoked glass and their data will not be known until the balloons burst in the rarefied air and fall to earth.

The balloons are expected to reach altitudes of from ten to fifteen miles before they burst and drop the shock-proofed instruments to earth. Each will carry an identification tag offering a reward for return to the institute, a system proved very successful in previous studies in other parts of the country.

The Cuban section, working with Father Eugolio Varquez, of Belen College, will use two types of radio meteorographs: the Vaisala type developed by the head of Finland's weather service and the instrument developed by Charles F. Brooks and Karl O. Lange, of Harvard's Blue Hill Observatory. The receiving station for these miniature transmitters will automatically record the data of the hurricane-swept skies.

Through the cooperation of the U. S. Weather Bureau and the special hurricane forecasting station at Jacksonville, Fla., an attempt will be made to release the balloons before the storm, not only to record the changes when it strikes, but to be sure they reach the upper air before being beaten to earth.

From the research meteorologists hope to extend present scanty knowledge on weather conditions, not so much during the fury of the storm, but when it is approaching, to facilitate forecasting.

HEAT RECORDS IN IOWA BROKEN

By Dr. Frank Thone

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Heat records for 117 years in Iowa have gone down with a crash this summer, as records for intense and continuous cold splintered on last winter's ice. A statistical survey of the heart of the corn belt, county by county and town by town, conducted by Charles D. Reed, of the U. S. Weather Bureau office at Des Moines, has shown that in the short space of about six months, Iowa has experienced the most prolonged severe cold and the most prolonged severe heat since Americans first settled in the territory and began keeping records, in 1819, a few years after Thomas Jefferson had "put across" the Louisiana purchase.

It is a confirmation, in sober meteorological data, of the school boy's unconsciously ironic definition of the temperate zone as "the part of the world where is g awfully hot in summer and awfully cold in winter."

While Mr. Reed conducted his study strictly wit the boundaries of his own jurisdiction, many of his figu are of interest outside the state, for as all midwestern are painfully aware, the heat was by no means confi to Iowa.

Many towns will date their "hottest ever" days fr the summer of 1936; others will have records of hott two days, hottest three days, hottest week, hottest t weeks, and so on up to hottest thirty-seven days. this point Mr. Reed quit simply because he hadn't a more space on his tables, and because his office force w all worn out with adding up and averaging endless pi of data.

Along with heat went terrific evaporation rates. T official evaporimeter on the campus of the State Colle at Ames showed a total evaporation of fourteen and th quarters inches for the month of July. This is with two tenths of an inch of the record evaporation at Tri une, Kansas, out where it is supposed to be really dry.

The hottest afternoon that the state as a whole e experienced was on July 14, of this year, when the av age maximum temperature at 113 observing stations w 108.7 degrees. This is 2.3 degrees higher than the pr vious record heat, of the afternoon of August 3, 1930. other days even higher temperatures were experienced some parts of the state, with the mercury climbing high as 113 to 117 degrees. The temperature map f July 14 shows that no county escaped heat of more th 100 degrees, and that most counties had to put up wi 110 degrees or worse.

This year's poor corn crop is blamed by Mr. Reed mo on the terrific heat than on drought. Water in the so was short, to be sure, but the crop got along rather we until the heat was turned on. The corn did not perish t thirst, it was burned to death.

Mr. Reed's study is published in the Weather Burea publication, *Climatological Data,* Iowa section.

ITEMS

An attack on the last major front in the war against communicable diseases is being undertaken at the Har vard School of Public Health. Victory in the first en gagement was reported by Dr. William F. Wells at th symposium which is a part of the Harvard Tercentenary celebration. Disease germs that enter the body throug the nose and throat, such as cause the common cold influenza, measles, meningitis and infantile paralysis, ca live in the air and be spread throught the air, Dr. Wel believes. He has proved that this is the case for some of these germs, notably influenza, and he has found that some, at least, of these germs in the air can be kille by ultra-violet rays. Influenza, pneumonia, infantile paralysis and the rest of the air-borne diseases may, in the opinion of Dr. Cecil K. Drinker, dean of the Harvard School of Public Health, in future be conquered by air purification with ultra-violet light or other means. Ty phoid fever and other intestinal diseases were largely conquered by purification of water and food supplies when it was found that water and food carried the germs of the intestinal diseases.

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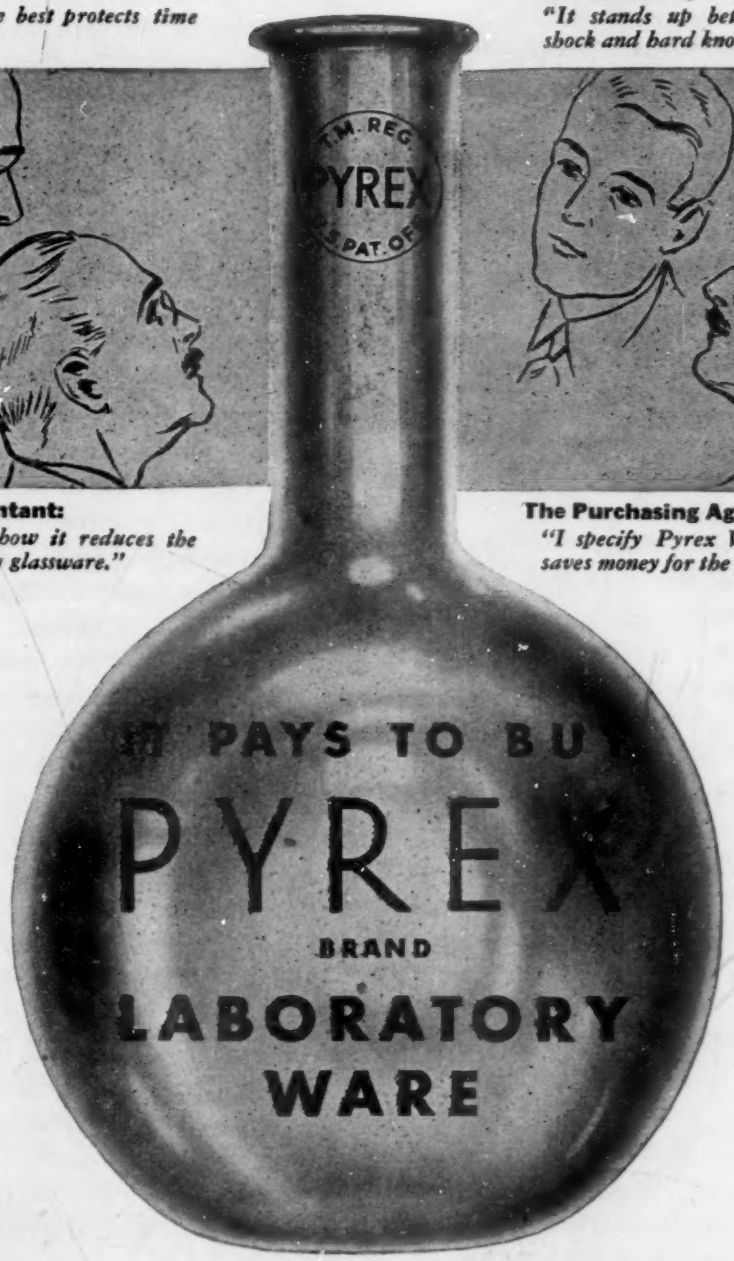

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SCIENCE NEWS

Science Service, Washington, D. C.

EXTENSION OF EINSTEIN'S THEORY OF RELATIVITY

By WATSON DAVIS
Director, Science Service

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MORE precise in defining the fundamental law of the universe than even Einstein's general theory of relativity, Professor Tullio Levi-Civita, professor of mathematical physics at the University of Rome, on September 4 announced at the Harvard Tercentenary Celebration new relativistic formulae that apply to two bodies instead of just one as in the case with those of Einstein.

Hailed as an important contribution to the understanding of the motion of heavenly bodies, the new work may herald an advance of somewhat the same character as occurred as the result of the Einstein era of astronomy and physics that began shortly after the World War.

Previous verifications of the general theory of relativity dealt only with gravitational fields due to a single body. In the classic case of the advance of the perihelion of the planet Mercury, Einstein considered the field as due to the sun alone, an approximation which is legitimate owing to the smallness of the ratio of the mass of the planet to that of the sun. But Professor Levi-Civita now considers the corresponding problem for two bodies of comparable mass as for instance two suns or stars whirling around each other.

His equations show that it is possible to visualize the force exerted as consisting of two parts, one an attraction that acts the way Newton assumed and the other an Einsteinian perturbation. These two together produce an advance of perihelion. This is not so surprising, but it is strange that the center of gravity of the motion wobbles slightly instead of being at rest or moving uniformly in a straight line.

Einstein's sensational prediction of the advance of Mercury's perihelion which brought his general theory of relativity into prominence was tested by direct observation. The revision of the Einstein theory that Professor Levi-Civita suggested can not be tested upon the planet Mercury with quite so much ease, but he does expect that astronomers will test it by observations upon double stars which are gigantic systems of twin suns seen as one spot of light in telescopes, but capable of being disentangled by their spectra or "rainbows" of light.

Professor Levi-Civita's solution of the relativistic problem of several bodies will probably be the focus of mathematical and astronomical work for several years to come. The expounder of this new relativistic view is no novice in mathematical physics. He has been a leader in hydrodynamics, theoretical dynamics and pure geometry. His contribution to the theory of absolute differential calculus is credited with helping to lay the foundation for the general theory of gravitational relativity of Einstein.

THE COSMICAL CONSTANT AND THE RECESSION OF THE NEBULAE

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IN his own characteristic way Sir Arthur Eddington, noted British astronomer of the University of Cambridge, mildly chided both the relativity theory and the quantum theory for artificiality in his address at the Tercentenary Celebration of Harvard University.

Speaking on "The Cosmical Constant and the Recession of the Nebulae," Sir Arthur set up a simple ideal problem in cosmology and attempted to solve it by mathematical attack on the large, or macroscopic scale through relativity and also on the small or microscopic scale through quantum theory.

His intent in doing this, he indicated, was to find some link in meaning between the important constants "K" of gravitation and the cosmical constant "lambda" in the relativity theory, and the equally important constants of quantum theory—Planck's constant "h" and the other microscopic constants.

The two answers to his hypothetical problem linking relativity and quantum theory, he said, must agree and should disclose hitherto unrecognized relations between the mutual constants. Both quantum theory and relativity theory have inherent artificialities which make the problem difficult. For example, Sir Arthur said, "We had to catechize the quantum physicist, who writes down a wave equation for two or three particles, as to what he had done with the rest of the universe. Similarly when the cosmologist treats the curvature of a vacuum (in relativity theory) we have to ask what he has done with the particles removed."

The ideal problem he proposed for solution is to find the state of equilibrium of a radiationless, self-contained system of a very large number of particles, both positive and negative. The first step is to obtain the projection of the spherical Einstein universe into a flat space. A spherical space of uniform density throughout, he disclosed, becomes, after projection, a flat sheet with a density distribution concentrated toward the center and fading off to zero at infinity. This distribution resembles the distribution of electron density in the atom of the physicist.

Without following the details of Sir Arthur's mathematics it can be explained that he arrives at a value for the number of particles in his idealized universe problem which he calls a "deputy cosmical constant." To distinguish it from the important cosmical constant lambda, he calls it the "cosmical number." "I feel satisfied," he said, "that the cosmical number is precisely $2.136.2^{256}$." The number of particles in this Eddington universe would be 2 multiplied by itself 255 times and then multiplied by 272.

From his mathematics Sir Arthur was also able to calculate the limiting maximum speed of recession of the

distant nebulae which checks fairly well with observed measurements on the expansion of the universe. The limiting speed, he said, is 432 kilometers per second per megaparsec. The first part, 432 kilometers per second is, of course, a velocity amounting to 268 miles a second, or 964,800 miles an hour. A parsec is an astronomical unit of distance equal to 3.26 light years or about 20,000,000,000,000 miles. And a megaparsec is a million parsecs. Therefore, for every 20,000,000,000,000,000,000 miles one goes out into space the velocity of recession of the nebulae increases by 964,800 miles an hour.

ADDITIVE NUMBER THEORY

By Watson Davis
Director of Science Service

Hailed as one of the greatest recent advances in the science of numbers, Professor Leonard Eugene Dickson, of the University of Chicago, presented to the Harvard Tercentenary Celebration the first rigorous proof of an extension of one of the problems that has wrinkled the brows of mathematicians since the middle ages.

Ranking with the famous and impossible trisection of the angle as a brain puzzler, the task Professor Dickson set himself and solved is what is called "additive number theory" or "Waring problem."

In its simplest form, the one that was discussed during the middle ages, the problem concerns the fact that every whole number is either an exact square or the sum of two, three or four squares. By a coincidence, the famous mathematician Fermat in 1636—the year of the founding of Harvard University which is now being celebrated—first discovered the general theorem.

Many of the best brains in the world have set themselves the task of working out the rules, formulae and proofs, and as early as 1772, a mathematician named Euler—son of a more celebrated mathematician—worked out the formulae for any power.

Amateur mathematicians may wish to ponder over it. Here it is. To express any number as the sum of two other numbers raised to any selected power, for convenience designated mathematically by the small number n, the maximum number needed of numbers so raised to the selected power is found by raising two to the selected power, subtracting two and then adding the fraction three over two raised to the selected power, discarding the decimal fraction.

For squares the answer is four, for cubes it is nine, and for fourth powers it is 19, for fifth powers it is 37, and so on. Mathematicians know and have confidence in this rule, but it had never been rigorously proved for any but squares and cubes. Professor Dickson's achievement is to prove it rigorously for all powers from the seventh power to infinity powers. How did he do it? He did not even try to tell in the one lecture he gave. He explained that it would take 120 lectures to mathematically-trained listeners to give full proof.

There are still three powers in additive number theory that have not yet been conquered, the fourth, fifth and sixth powers. Professor Dickson expects to work out the proof of these also.

Professor Dickson glories somewhat in the impracticality of this particular branch of mathematics. It has been useful in the mathematics of the new quantum theory of physics, wave mechanics, and so on. But it hardly is useful as yet to practical chemists, physicists and engineers who apply science to every-day life. That does not mean that it will not be useful in the future.

Going back to the formula for a minute, Professor Dickson on the back of an envelope worked out the maximum number of terms in a series of seventh powers that will add up to any number. It was 143.

EFFECT OF PITUITARY GLANDS ON MAN'S BEHAVIOR

Dr. James Bertram Collip, professor of biochemistry at McGill University, reported at the Harvard Tercentenary Celebration, on September 7, that the small pituitary gland in the head has more to do with man's behavior than any of the other glands.

All the glands have an important influence on behavior, but the pituitary, because of the way it affects each of the other glands and various other organs of the body, has the greatest effect. Dr. Collip explained how the glands and nervous system work together in man and higher animals. The glands themselves are influenced by the nervous system, but the chemicals they produce, known as hormones, may in turn affect the nervous system.

Scientific knowledge of the glands shows how widespread their influence on behavior is, but it does not justify some of the "fantastic" claims that have been made. Dr. Collip warned his hearers against overlooking basic principles in interpreting behavior on glandular grounds.

As an example of the way in which the pituitary gland affects behavior, Dr. Collip cited the case of a wolf-hound puppy studied in his laboratory. Soon after removal of this animal's pituitary gland, it was noted that the puppy, although belonging to a naturally aggressive stock, became extremely timid and stupid in his behavior, which was entirely different from that of a normal wolf-hound puppy. A few days after treatment with anterior pituitary extract, the animal's behavior changed markedly again, so that he became much more like the normal puppy of his breed. The change was so apparent that a worker in the laboratory, unaware that treatment had been started, commented on the unusual activity of the puppy and asked if anything had been done which might account for it.

Even more dramatic was the case Dr. Collip cited to show how more than one set of glands may similarly affect body mechanisms and behavior. This was the case of a man who had diabetes and was having insulin treatment. In this condition it sometimes happens that too much insulin has been given, or not enough carbohydrate food is eaten. The patient then suffers from too little sugar in his blood, has convulsions and will become unconscious unless given some sugar or other carbohydrate at once.

The patient Dr. Collip described was walking down the street one day when he felt such an attack coming on and realized that he had forgotten to provide himself with a chocolate bar for the emergency. He went at once to a

drug store and tried to explain to the druggist what he wanted. But by that time his gait was unsteady and his speech incoherent. The druggist thought he was a drunken man and threw him into the street. The patient became enraged at this treatment, promptly recovered, and was able to proceed to another drug store where he made known his wants, obtained what he needed and continued on his way.

In this case, Dr. Collip explained, another set of glands, the adrenals, became activated by anger and released enough of their hormone, adrenalin, to cause an increase of the patient's blood sugar sufficient to restore his equilibrium and powers of speech. The insulin-producing islets of Langerhans in the pancreas are the glands primarily concerned with control of the body's use of sugar, but the case of this patient shows how the adrenalin glands also may affect sugar utilization and also behavior.

THE BRAIN AND HUMAN BEHAVIOR

IF man's life is ever to be lived along entirely rational lines, free from such disturbances as war, crime and economic booms and depressions, he will have to find a way of increasing the size of his brain.

This is the conclusion to be drawn from what Professor Edgar Douglas Adrian, of the University of Cambridge, Nobel laureate and one of the pioneers in "brain wave" investigations, reported at the Harvard Tercentenary Celebration concerning the relation between the nervous system and human behavior.

Scientific investigations into the mechanism of the mind and body, by "brain waves" and other techniques, show that the only certain method by which human behavior can be improved is the apparently impossible feat of breeding men with larger brains.

"It is tantalizing," Professor Adrian said, "to think of the new relations we should see, of the new world of thought we should live in, if our brains were but twice their present size. Our behavior would then be superhuman!" Not even the most fanciful mind, given to picturing a race of supermen in a world to come, could conceive of the result, which Professor Adrian described as "beyond the power of human thought."

It is unlikely, he said, that neurology, the study of the brain and nervous system, will give new methods of control over human behavior, though it will certainly improve some of the methods that already exist, such as the control of behavior by drugs. The new narcotics which "give peace of mind before a surgical operation" show what may be expected in the future from this method of regulating our brains and controlling our behavior.

Studies of the electrical activity that accompanies brain activity, the so-called brain waves, may show what takes place in the brain during the learning process, when new associations are formed in the brain, and why an incentive of an emotional sort is necessary to this process. There are definite changes in the electrical activity of different regions, Professor Adrian pointed out, when we direct our attention from the visual field to the auditory, and *vice versa*. These are not beyond analysis and ten or even twenty years from now he believes that much more about the nerve changes that take place during certain mental processes will be known. The nerve mechanism of consciousness itself, however, will perhaps never be discovered.

ITEMS

FROM excavations in the Aleutian Islands this summer, Dr. Hrdlička is convinced that these islands that swing out from Alaska toward Asia were once thickly inhabited. They contain hundreds of sites, many of them pre-Russian. And in the days when America was being populated by its original "natives," these Aleutian Islands were probably a secondary highway which carried wanderers into this continent. Bering Strait, farther north, has long been recognized as the primary highway of the ancient migration, but the Aleutian Islands have heretofore been considered a mere side-track into which some groups drifted from the Alaskan side.

MORE than thirty settlements of human beings dating from the Stone Age, or about the year 3000 B. C., have been unearthed in Swedish Lapland by Kurt Tinnberg, of Stockholm. In a few months he has gathered some 3,000 flint tools, weapons and utensils, said to be the most northerly ever found in Sweden. According to Mr. Tinnberg, researches show that the climate of Scandinavia in those distant days was warmer than now. To support his theory he points to recent finds indicating that grapes grew wild in Sweden more than 4,000 years ago.

CHILDREN brought to the General Hospital in Cincinnati when suffering from painful burns and scalds soon are made to laugh and temporarily forget their injuries in the new burn-treatment room recently opened. Swifter and easier emergency treatment in the crucial initial stages of burns is the result. Animal cut-outs of fairy-land characters dot the walls. Tubs for bathing the children with soothing liquids are in brilliant colors as are the tile floors. A huge electric kaleidoscope flashes hundreds of colored designs on the walls. Dr. H. Jerry Lavender, of the hospital staff, designed the so-called "fun room," which is working out successfully.

FOREIGN-BORN persons in New York State are no more subject to mental disease than are native Americans, if allowance is made for difference in age and environment, Dr. Benjamin Malzberg, of the New York State Department of Mental Hygiene, in the *American Journal of Psychiatry*, reports that although the average annual rates of first admissions to mental hospitals seem to indicate that the cases of mental disease among foreign-born are twice as numerous as among native Americans, these figures are misleading. The foreign-born are older, on the average, than the natives and consequently have had more chance to develop mental disease. They are also more concentrated in cities, where mental disease, or at least hospitalization for it, is more common.

A SCIENCE NEWS note in SCIENCE for August 14 called attention to the broadcast of musical pitch which has been sent out by the Bureau of Standards for the past two weeks. There was, however, an error in that it is not a 400 cycle note that is being broadcast but a 440 cycle note.

Five Important New Books

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SCIENCE NEWS

Science Service, Washington, D. C.

SOME PAPERS PRESENTED AT THE HARVARD TERCENTENARY CONFERENCE OF ARTS AND SCIENCES

BY DR. FRANK THONE
Science Service Staff Writer

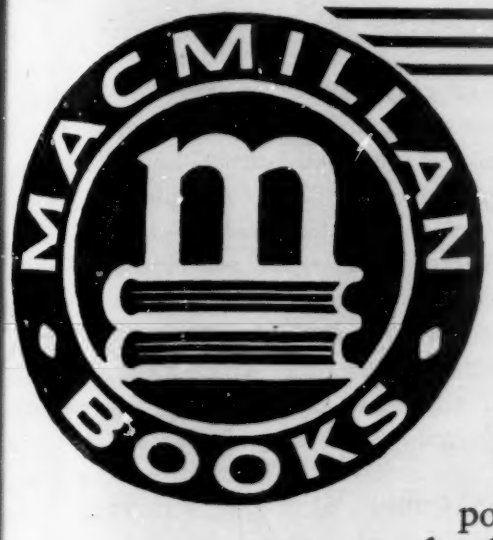
BACILLARY dysentery, one of the great health hazards of tropical regions, which occasionally reaches into more northern parts, is still unconquered, scientists gathered at Cambridge to celebrate Harvard's Tercentenary were told on September 5 by Dr. Kiyoshi Shiga of the Kitasato Institute, Tokyo. Dr. Shiga more than thirty years ago discovered the bacillus or germ that causes dysentery. To-day he told with keen regret, in poetic, foreign-sounding English that made the regret seem more poignant, how, in spite of this discovery and a lifetime of subsequent research, the disease still defies the efforts of himself and other investigators to wipe it out. "Discovery of dysentery bacillus had stirred my young heart with new hopes of eradicating the disease and saving the sufferings of about one hundred thousand cases that occurred at the time," Dr. Shiga said. "Thirty-eight years had passed since this heart-throbbing event happened. Many thousand people still suffer from it year to year, and the hope that once had been thought would bring new light had disappeared as a dream of summer night." In the years that passed since the epochal discovery of Dr. Shiga's youth, much new knowledge has been gained about the disease. Almost a hundred different strains of germs that cause the disease have been discovered. The poison produced by the germ has been studied and found to rank next to the toxins of tetanus (lockjaw) and diphtheria in strength. An antitoxin has been prepared and found effective in mild and mediumly severe cases, but less effective in severe cases.

DIABETES is not merely a matter of the health or sickness of a single gland, the pancreas; it involves many other glands and tissues of the body. That this disease is basically a disturbance of a balance among many gland secretions is the view of Professor Bernardo A. Houssay, of the University of Buenos Aires, presented before the conference. The pancreas, whose secretion, insulin, enables the body tissues to burn up sugar, is balanced conspicuously against the liver, in which sugar is manufactured and stored. If the liver is out of action, diabetic concentrations of sugar in the blood can not occur. Another gland important in the body's sugar balance is the front part of the pituitary, situated under the brain. The function of its secretion is opposite to that of insulin: It prevents too low a blood sugar content, as insulin operates against the accumulation of too much sugar. A similar sugar-maintaining effect results from the thyroid gland's secretion, and one of the tasks performed by the cortex of the adrenal gland. Nervous connections do not seem to have any important place in the whole blood-sugar picture. If nerves to the glands are severed the glands function any way, being stimulated by the hormones or "chemical messengers" from other glands.

THE sneezes of the hayfever sufferer, the hives of the person who is upset by eating fish, the rash or more severe reaction that follows taking a drug in persons hypersensitive to it, are all signs of a "very comprehensive and remarkable biologic phenomenon," Dr. Karl Landsteiner, of the Rockefeller Institute for Medical Research, told his colleagues. Best known for his discovery of the blood groups, Dr. Landsteiner has investigated other features of blood, such as its mysterious antibodies which fight invading disease germs. From that he has branched over into a study of the body mechanisms for resisting other foreign substances, particularly chemicals taken into the body as drugs. The antibodies, Dr. Landsteiner believes, play a defensive rôle not only against disease germs but in allergies, such as hayfever, and in drug idiosyncrasies, although investigators have not yet been able to demonstrate their presence in all cases. By means of these antibodies, circulating in the blood or fixed in body tissues, the body adapts itself to various chemical agents. "If successful, this mechanism guards against infectious disease," Dr. Landsteiner said, "but when it miscarries it induces sensitivity to exceedingly small quantities of proteins or simple chemical compounds."

CHEMICAL isotopes are being used in Denmark to trace the course of water, minerals and organic substances through the physiological processes of plant and animal bodies. Some of the results were reported by Professor August Krogh, of the University of Copenhagen. Professor Krogh and his associates have been giving isotopes of various nutrient elements to plants and animals, and afterwards analyzing the tissues from various parts to find out where the isotopes went. They found, among other things, that radioactive phosphorus traveled around plants a good deal more rapidly than had previously been thought to be the case. Also, radioactive phosphorus turned up in the dentine of teeth, which has always been thought to be pretty well cut off from the rest of the body. Another series of experiments, using "heavy water," showed that water gets around through the body of an animal quite rapidly, once it enters, and that any given quantity of water comes to be distributed pretty evenly throughout the whole body. Water-dwelling animal forms were shown to be capable of absorbing water through their gills, and also through their skins when these were not too thick.

FROM another Baltic country came a report on investigations into the size and make-up of the protein molecule, among the largest and most complex of atomic aggregates. Professor The Svedberg, of the University of Upsala, told of methods and instruments evolved in his laboratory, which include an ultra-centrifuge that can whirl solutions at a rate of from sixty to seventy thousand revolutions a minute. This separates out intimately mixed things, as cream is separated from milk in a cream separator, and



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permits physical and chemical examinations to be made of the parts. Professor Svedberg's results confirm the idea previously held, that protein molecules are relatively enormous, containing tens or even hundreds of thousands of atoms each, as against a mere half-dozen or dozen in common inorganic compounds, or a few scores or hundreds in the simpler organic molecules. Also, it was found that these huge molecules were not built up single atom by atom, but that whole blocks of atoms were manipulated at a time. That is, they were not put together a brick at a time, like a mason erecting a wall, but more like bolting together the whole sides of a knock-down house.

THE mystery of plants' ability to capture sunlight and use its energy in forming food for all the world has been brought several steps closer to final solution by a German holder of the Nobel prize, Professor Hans Fischer, of the Munich Technical College. He reviewed at the conference his long researches on chlorophyll, the green synthesizer in plant leaves and stems, and told of its recent progress. The ultimate aim is the synthesis of this complex molecule, which will enable scientists the better to understand and control the vital processes of plants. Chlorophyll synthesis has not yet been accomplished, but Professor Fischer intimated that he hopes to get it done in the not too far distant future. Of perennial interest to physiologists and chemists is the relationship between the green pigment of plant leaves, chlorophyll, and the red pigment of blood, hemoglobin. A hemoglobin molecule consists of a huge lump of a protein molecule with four porphyrin rings attached, each with a single atom of iron at its center instead of the chlorophyll's single magnesium. The chemical basis of chlorophyll is a four-sided arrangement of carbon and nitrogen atoms, called the porphyrin ring. With some extra groups of atoms attached around the outside, one long atomic chain called the phytyl alcohol group tacked onto one corner, and a single atom of magnesium stuck squarely in the center, the porphyrin ring becomes the chlorophyll molecule.

CHEMICAL commanders in the bodies of embryo animals, giving orders that are received and obeyed by the developing parts, were described by Professor Hans Spemann, of the University of Freiburg, Nobel laureate. The mode of action of these commanders is known, and the places where they can be found during bodily development; but their exact identity remains a secret. Nobody has ever got one out, whole and separate, and made a complete chemical analysis of it—Professor Spemann is still digging at that part of the problem. When embryonic development begins, with the fertilized egg cell, there forms first a hollow globe of cells, with a tiny opening at one side, the blastopore. At this stage therefore there is neither head nor tail to the animal, nor much of anything to suggest where these regions and the other organs will eventually be. But Professor Spemann found that if he took a bit of the lip of the blastopore from one of these early-stage embryos, and transplanted it onto another embryo at the same stage, this transplanted bit determined a head-to-tail body axis. Since the second embryo already had its own blastopore, there were two axes, and a double embryo developed.

A SIMPLIFICATION of the problem of polarity in living organisms was offered by Professor Ross G. Harrison, of Yale University. He was led to the formulation of his theory by the phenomena which he has observed through many years of experimentation on very early embryo stages of spotted salamanders. Salamanders are little amphibian animals shaped like lizards, but really closer relatives of frogs and toads. The developing animal egg may seem on casual examination to have no head or tail to it, but long before such organs are externally visible the egg itself develops a decided top-and-bottom internal arrangement, with definite signs of right-and-left orientation as well. "Head" end is chemically different from the "tail" end, and there is a chemical and electrical gradient ranging through the space between them. Professor Harrison sees a theoretical picture of the protein molecules, which are known to be long, string-like affairs, and chemically different at their opposite ends, arranging themselves in parallel formation like soldiers in a regiment, so that the effects of their individual polarities become added together, to produce the greater polarity of the organism.

THE strange biology of multiple birth among insects was discussed by Professor Filippo Silvestri of the Royal College of Agriculture, Portici, Italy. In this mode of "super-quintupling," most familiar to scientists in certain parasitic members of the wasp family, the number of individuals eventually resulting from the hatching of a single egg ranges from ten or fifteen to hundreds and even thousands, depending on the species concerned. The phenomena is called "polyembryony," or the condition of many embryos. When the insect's egg begins to divide, it first forms a mass of cells, such as constitute an early stage in the development of any individual. But this cell mass does not proceed to organize and differentiate into the various body parts, in the ordinary fashion. Instead, it breaks apart into separate cells, or small groups of cells; these re-multiply into considerable cell-clumps, and then proceed to turn into larvae, which eventually change into the fully developed insects. What causes this breaking apart of the original cell mass is still a point of dispute among biologists. Professor Silvestri is inclined to the opinion that since these insects are all parasites, developing from eggs laid in the bodies of larger insects by their mothers, the presence of abundant fluid, rich in nourishment, may make the first cells more independent of each other than are the cells in comparable early stages of development in other animal forms. Certainly polyembryony is an advantage to the species that practice it. It results in more rapid multiplication, and hence increases the chances of survival and spread for the species, in a world where its peculiarly selective habits of egg-laying impose pretty heavy handicaps. To man, also, the process offers certain benefits. The insects described by Professor Silvestri belong to the large class of tiny, gnat-size wasps that lay their eggs in the bodies of other insects, particularly caterpillars. Their larvae feed on the tissues of these involuntary hosts, eventually killing them and cutting short their careers of crop destruction. When a single egg releases from a dozen to a thousand of these tiny borers from within, the caterpillar's career is so much the shorter, and its possibilities of harm correspondingly the less.

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SCIENCE NEWS

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THE BREATHING RHYTHM

AN explanation of the rhythm of breathing was given by Sir Joseph Barcroft, professor of physiology at the University of Cambridge, at the Harvard Tercentenary Conference.

Three different explanations have been considered for the rhythmic in-and-out of air in respiration. According to one explanation, breathing in starts a message to the brain which checks the inhaling phase and starts the exhaling phase of breathing. This exhaling, in turn, sends a message to the brain that checks the exhaling and starts the inhaling phase.

According to another explanation, there is a continual urge in the central nervous system, which includes the brain, to breath in, but the act of inspiring sets up sensory impulses which check the effort. The lung then passively returns to its unexpanded condition, which takes care of the exhaling. According to this explanation, the brain and central nervous system is the essential seat of breathing and does not merely act as a telephone exchange.

The third view is that breathing is due to rhythmic activity of the central nervous system. The sheep embryo experiments, undertaken with another purpose, unexpectedly furnished support for this view. Sir Joseph and his associates were seeking the solution of another scientific problem, that of how the first movements of the unborn young of mammals start. Do the ordinary movements of legs and arms and other parts of the body arise from generalized mass movements of the whole body, or do the localized movements develop into generalized motions all over the body? The answer was sought by studying the large and slowly growing embryo of the sheep. It was found that the mass movement is built up from localized movements and when built up can be resolved into localized movements which have definite significance and purpose.

A stimulus such as tapping the sheep's snout with a fine glass rod starts a localized movement of the snout and head. Later this stimulus sets up rhythmic movements through the whole body, mass movements which start with the local stimulus to the snout. At a still later stage, these rhythmical mass movements break down and more localized ones appear in response to the stimulus, such as straightening and stretching of tail and limbs. At first these stretching movements are spasmodic, later they become rhythmic. At a still later stage, the lamb fetus is so lively that the rhythmic movements are practically constant and the fetus looks like an ordinary animal breathing naturally. A stimulus at this stage produces more energetic rhythmic movements that give the appearance of an animal out of breath as the result of effort.

The inference is that these rhythmic body movements, which may be elicited by a stimulus to the sensory nerves, show a rhythmic activity of the nervous system which would account for the rhythm of breathing as well as for rhythm in other body activities.

SECONDARY COSMIC RAYS

SPEAKING at the Harvard Tercentenary Celebration, Dr. W. F. G. Swann, of the Bartol Foundation of the Franklin Institute, presented mathematical arguments to the effect that photons are not necessary as primary components of cosmic radiation. Charged particles suffice to explain everything if only one makes certain assumptions as to the way these particles behave. And Dr. Swann has found by means of mathematics just how particles must behave in order that the whole body of cosmic ray facts may be clarified on the particle basis alone.

Little is known of the habits of these fast-flying bits of electricity. Some of the characteristics which Dr. Swann has ascribed to them have been observed by other investigators. Other traits with which he has endowed them are entirely original suggestions and have not, as yet, been brought to the test of independent experimental check.

Some of the things which must be true of the electrified particles if they are to constitute the whole cosmic ray story are the following: (1) There must be two kinds of particles; (2) as they pass through matter, both kinds must lose energy at a rate which increases as the energy of the original particle increases; (3) both kinds of primary particles must produce other high speed particles (called secondaries) by collision with atoms in the air; but the facility with which they do this is different in the two kinds.

The crux of this theory is the way in which the secondary cosmic rays are treated. The existence of secondaries is a well-known fact. But heretofore they have constituted a sort of "mess" which obscured the real cosmic ray facts. According to Dr. Swann's view, however, they are practically the only thing any one observes, and, more than that, they can serve to lead the experimenter back to those real facts which lie behind the scene.

Puzzling to physicists has been the scarcity of very high energy particles when cosmic rays were being watched in the Wilson cloud chamber. For it was known from experiments dealing with the effect of the earth's magnetic field that much of the incoming radiation must have energy greater than ten billion volts. This paradox disappears in Dr. Swann's theory. Compared with the large number of lower energy secondaries, the high-speed primaries are very rare indeed. They may be likened to an "unseen hand" which guides the behavior of the secondaries, and it is through the study of these locally generated particles that the true nature of the ones from outer space can be decided.

HEAT PHOTOGRAPHS

THE discovery of very faint stars closer to the earth and sun than any now known was predicted at the Cambridge meeting of the American Astronomical Society, following a report by Dr. C. W. Hetzler, of the Yerkes Observatory of the University of Chicago, that "heat photographs" of the sky had discovered new stars too

faint and cool to be recorded on ordinary photographic plates.

By using the new rapid infra-red plates cool stars of only a thousand degrees temperature can be photographed with conspicuous success. Heretofore the lowest temperature stars captured by astronomical photographs were at least two thousand degrees.

At present the known star closest to the earth is Alpha Centauri whose light takes four and one third years to reach the earth. An immediate search for small faint stars that may be closer is planned by Dr. Hetzler. The new "heat-seeing" photographs are also expected to result in the discovery of more comets and asteroids, the small fry of the solar system which escape the astronomers' eyes and ordinary photographic observation. Another use of the new observational method will be in a search for stars cooler and perhaps larger than the well-known red, low temperature giants like Antares and Betelgeuse.

The great cloud-like patches of light, so spectacular in astronomical photographs and known as diffuse nebulae, are really dust clouds that mirror the light of near-by stars, according to Drs. Otto Struve, C. T. Elvey and F. E. Roach. Dr. Struve told how he had proved that these nebulae within our own stellar system, the Milky Way, shine by reflected light and consist not of gases but of relatively large aggregates, cosmic dust particles of about one thousand atoms each. These diffuse nebulae reflect the red light near-by of red stars without change, much as sunlight is often reflected beautifully on a fleecy cloud in another part of the sky. If, instead of a red star, there is a blue star near-by, the mirror-like nebula sends out blue light. This is proof that the particles in the nebula are not small like the gas particles in the earth's atmosphere. On the earth the sky is blue because the layers of atmosphere scatter the blue in the sun's light more effectively than the red wavelengths.

Dr. Struve's explanation of one of the puzzles of the sky comes as the first results from McDonald Observatory on Mount Locke, Texas, which is conducted jointly by the University of Texas and the University of Chicago. Dr. Struve is director of both the Yerkes and McDonald Observatories.

The big telescope for McDonald Observatory is not yet ready for use but this investigation was conducted with a sort of "candid camera" of the sky: the Schmidt camera telescope which has a wide field and great light-gathering power that allows short exposures.

NUTRITION AND HEALTH

EATING to live, to live abundantly and healthily, was the central idea of a symposium by members of the faculty of the Harvard Medical School as a part of Harvard's celebration.

Dr. George R. Minot, who presided over the symposium, reminded his hearers that interest in right diet has been on the Harvard campus since the very beginnings of Harvard College. One of the books from the John Harvard library, forming part of the original endowment, was a popular text on nutrition; and a magistrate had to hear the wife of the first professor accused of not feeding the students well enough.

Mention of nutrition probably conjures up visions of "solid food" in the minds of most of us; but the foods we assimilate would do us no good if they were not transported about the body in fluid state, and if wastes were not removed. The wateriness of the human body is proverbial. For this reason, perhaps, the symposium started with a discussion by Dr. J. L. Gamble, of the extracellular body fluids. One fifth of our total body weight consists of fluids outside the living cells. Of this fraction, a fourth consists of the liquid part of the blood, the plasma. The mineral salts in these important body fluids are kept in proper balance by the kidneys, while the carbon dioxide is maintained at the proper level through the action of the respiratory apparatus.

Not being red-blooded is more than a moral or social taunt, from the medical angle; it may mean a very serious lack of health. Several things can cause deficiency of hemoglobin, which gives blood its red color, according to Dr. Clark W. Heath: iron demands for growth, the even more imperious demands by a child on its mother both before birth and during nursing, or the outright loss of blood through a wound. One type of liver extract has been found useful in correction of this deficiency, also minute doses of copper, and possibly the therapeutic use of chlorophyll and bile pigment.

Protein deficiency amounts to a serious diseased condition, Dr. Chester M. Jones explained. Sheer poverty, making it impossible to provide enough meat, eggs and milk, is a tragic cause. Less inexcusable are such derangements as malabsorption, diabetes, nephritis and several other internal diseases.

Defective function in the digestive tract is a frequent cause of failure to digest and absorb food. Dr. William B. Castle explained some of these conditions. In extreme cases, the inner surfaces of the organs may be simply too sore to work, as in pernicious enemia, pellagra and several other ailments. Thus the luckless patient is caught in a vicious downward spiral of malnutrition.

VITAMIN C AT WORK

THE rôle of vitamin C as a bone-maker is familiar, but bone is not the only tissue with which this food element is concerned. Dr. S. Burt Wolbach, speaking at a tercentenary symposium at the Harvard Medical School, told of others: cartilage, certain types of connective tissue and the enamel of the teeth. In general, vitamin C conducts its business not in the cells but between them, for all these tissues are classed as "intercellular."

Dr. Kenneth D. Blackfan emphasized the desirability of careful diagnosis, by means of newly developed chemical tests, for the early recognition of vitamin-deficient states. This is not easy, for the various deficiency diseases are very insidious, and are specially likely to attack children at early ages. But they are so much more easily overcome when caught in early stages that the extra effort is worth while.

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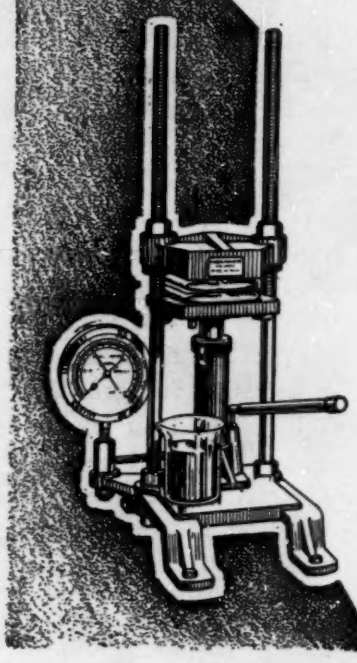

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SCIENCE NEWS

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THE METHOD OF SCIENCE

THE future of mankind depends on man's learning to use the method the scientific man uses in solving his problems. This was the message of physics to medical x-ray science as conveyed by Professor Robert A. Millikan, of the California Institute of Technology, at the Cleveland meeting of the American Roentgen Ray Society.

Professor Millikan stated that man must learn the scientific mode of approach before he will solve the worst of his social or governmental ills. The method of science is always to utilize the knowledge of the past as a platform from which to make advances into the future. In every single case the scientist starts with the accumulated knowledge of the past and pushes a little further along, and then from this slightly advanced platform builds still a little further, and so on and on, always pushing ahead from the last platform of all past knowledge.

Professor Millikan sketched briefly the way in which this scientific method of approach was used in exploring the field of electromagnetic radiation from x-rays and ultra-violet rays to cosmic rays. The knowledge gained in this field is of tremendous importance and usefulness, but the method by which it was gained is even more important. Dr. Millikan pointed out that this scientific method of approach is "vastly more important for the future of the race than any particular bread-and-butter application in the whole field of radiation, no matter how important that field as shown by the fact that enormous industries—the whole communications industry and sound pictures, for example—have come out of it." He surveyed the field of radiation and described the ranges of particular interest to medical men. Among these is the whole range of x-ray and gamma ray frequency, the main use of which is "combatting mankind's most terrible scourge, cancer." This runs from a frequency in electron volts of about 12,000 up to 1,200,000 electron volts, which is the highest frequency which has been generated by an x-ray tube and used continuously for cancer treatment. These high potential x-rays are particularly appropriate for deep-seated cancers, the low potential tubes being successfully used to treat superficial cancers.

"It is not too much to say," Professor Millikan continued, "that the best of medical authorities agree that radiation is the most potent agent we now have for combatting the scourge of cancer, not even excepting surgery."

Passing from medical matters he continued his description of radiation as follows: "With the range of about 2,000,000 electron volts we end the highest frequency of radiation being regularly applied for therapeutic or other useful purposes, but Dr. Lauritsen, at the California Institute of Technology has recently discovered the existence of nuclear disintegration gamma rays which carry a frequency of artificially produced radiations up to 17,500,000 electron volts and this figure begins to overlap the enormous energies which we find in cosmic radiation, which, however, is completely unknown from any terrestrial sources. We have now studied these cosmic rays throughout the whole range of energies from twenty million electron volts to fifteen billion electron volts, and know a good deal about the way in which these stupendously powerful cosmic rays come into the earth and how they are absorbed by matter.

Professor Millikan briefly summarized the latest advance in knowledge of these rays obtained by sending into the stratosphere balloons carrying instruments with very exact recording mechanisms. These balloons reached up to 98.3 per cent. of the top of the atmosphere, at an altitude corresponding to 92,000 feet. An important fact learned from the balloon observations, made this past summer, is that at the latitude worked with, at San Antonio, Texas, the cosmic rays reach a maximum intensity at an altitude of about 68,000 feet and then decrease in intensity as higher altitudes up to 92,000 feet are reached. The complete interpretation of these observations can not be made until similar flights and readings have been made nearer the equator, Professor Millikan said, adding that he and his colleagues are now trying to obtain such flights.

MAN'S ANTIQUITY IN AMERICA

PREHISTORIC elephants, hunted to death by cunning primitive darts, have been unearthed in New Mexico, proving at last to scientific satisfaction that America was inhabited as long ago as 8000 B. C.

The discovery, which places America's famous Folsom Men more definitely than ever before in a niche of time, was made by a joint archeological expedition directed by the Academy of Natural Sciences of Philadelphia, the Carnegie Institution of Washington and the University Museum of Philadelphia. The site of the discovery is the region of Blackwater Draw, between Portales and Clovis.

Dr. Edgar B. Howard, of the academy, leader of the expedition, reported finding at the site bones of ponderous mammoths with stone spear points made by man associated beyond doubt with them. One of the ancient hunter's weapons lay under a vertebra, another under a shoulder blade, and another between the forelimbs of a beast. The prehistoric elephants thus slain were obviously trapped in a bog, where they floundered until the eager big game hunters could dispatch them with their pointed spears.

Bone points, the first of their kind ever discovered in connection with prehistoric elephants or with America's ancient Folsom Men, were unearthed at the scene. One of these bone points rested on the base of a mammoth's tusk.

The antiquity of the event, about 10,000 years ago, is estimated on geological and climatological evidence. The remains of the hunt, with the lost and discarded weapons,

were buried through the centuries by hard silt and several feet of sand, and remained undisturbed.

Scientific witnesses attending the excavation of the bones and weapons included Dr. Ernst Antevs, geologist of the Carnegie Institution; Dr. Harold Colton, of the Museum of Northern Arizona, and Dr. Frederica de Laguna, archeologist of the University Museum.

SOME PAPERS ON PUBLIC HEALTH AND MEDICINE AT THE HARVARD TERCENTENARY CONFERENCE

MILK, water and salt are hot weather health aids, it appears from studies reported by Dr. Cecil K. Drinker, dean of the Harvard School of Public Health, at the symposium on environment and its effect on man, held as part of the Harvard Tercentenary celebration. A man doing hard work in high temperatures must have plenty of food and water and he should take half an ounce of salt daily to replace the amount that will be lost from the body in perspiration. He can see no reason for limiting unduly the amount of protein food such as meat, eggs and cheese. For the white man, life in the tropics depends on a severe discipline which is hard to maintain. Dr. Drinker advises for white residents in the tropics a moderate amount of simple food, plenty of water, an adequate amount of salt, daily exercise, no alcohol or excesses of any kind, and plenty of sleep.

Lack of vitamins was blamed for two of the commonest forms of dental trouble by Dr. Percy R. Howe. Tooth decay and pyorrhea, he said, have never been successfully produced by bacteria under laboratory experimental conditions, whereas they readily occur in animals deprived of vitamins A, C and D, and certain essential minerals. Lack of vitamin A, he added, has been shown to be especially damaging to the outer enamel of the teeth.

Beri-beri is not the only nerve disease due to vitamin deficiency, Dr. Maurice B. Strauss stated. Conditions like those of this Oriental ailment have been found in nutritional upsets following alcoholism and pregnancy. In the first type of cases, the alcohol was shown not to be directly destructive to the nerves, since the condition could be corrected with the right kind of diet. Pernicious anemia and pellagra bring about a serious degeneration of the spinal cord, which may result in complete paralysis. Liver extract has been found effectual in combating this condition.

Protamine insulin, a new form of diabetes treatment, was praised by Dr. E. P. Joslin. It permits the number of doses to be reduced to one in twenty-four hours, it maintains a more nearly even level in the insulin concentration of the blood and it has made the treatment of diabetes so much less disagreeable that many persons who formerly refused insulin are now willing to use the treatment in its new form. This is especially true of children. Finally, as a promise of still further improvements in treatment, the discovery of protamine insulin has spurred investigators into renewed activity.

Trichinosis, a painful and sometimes fatal disease contracted through the eating of infected pork, is fully ten times as common as has hitherto been supposed. Not two per cent., but twenty per cent., of population samples studied had suffered from the malady at sometime in the past. This rather startling state of affairs in the nation's public health was discussed by Drs. Donald L. Augustine and W. W. Spink, of the Harvard Medical School, at a symposium on infectious diseases, part of the celebration at Harvard University. The figures are based on recent dependable studies of autopsy material in Boston, Minneapolis and Rochester, N. Y. Recent studies in his own laboratory have convinced Dr. Augustine that the commonly used diagnostic methods, of looking for the parasitic larvae in blood, spinal fluid and body wastes, are futile, and that microscopic examination of bits of the patient's muscle is of doubtful value. Far better, he stated, is a serological test which he has devised, using the parasites themselves to prepare an antigen. This method is specific for this one disease, except the skin tests when used in patients hypersensitive to other proteins.

ITEMS

THE safety record of the commercial airlines of America for 1936 is already worse than it was for the whole of 1935, it is revealed in figures released by the Bureau of Air Commerce. For the first six months of 1936, 25 paying passengers were killed in regular airline travel. Last year only 15 passengers were killed during the twelve months. The increase in deaths will make a large swing in the much-discussed passenger-miles per passenger fatality figures. In 1935 the airlines traveled 24,037,290 passenger miles per passenger fatality. For the first six months of 1936 this figure has dropped to 7,574,134 passenger miles per passenger fatality.

A DROP of 4.7 per cent. in automobile fatalities for the first eight months of 1936 over the same period in 1935 is reported by Metropolitan Life Insurance Company statisticians in reviewing the record for industrial policy holders. This decline has occurred in the face of increases in motor vehicle traffic and in the consumption of gasoline, the statisticians comment. The National Safety Council found a 2 per cent. drop in automobile fatalities up to the end of July, 1936, as compared with the same period of 1935. The council does not take too hopeful a view of the situation, however, for July was the third successive month to register an increase in auto deaths over the corresponding month of last year.

A TWO-ACRE Indian pyramid near Metropolis, southern Illinois, is to be sliced and tunneled by archeologists from the University of Chicago. Excavations will reveal whether the great flat-topped pyramid, 40 feet high, contains evidences of prehistoric Indian life in the region, or whether it was raised merely as a high earthen foundation for ceremonial buildings. Dr. Thorne Dueul, of the university, is directing the expedition which consists of fourteen students. The Kincaid mounds, where the great mound is located, are believed to have been an important center of Indian trade in the upper Mississippi Valley, and previous excavations have shown that the earth ten feet deep is sown with debris of human occupation. The lost cemetery of the ancient settlement is also to be sought.

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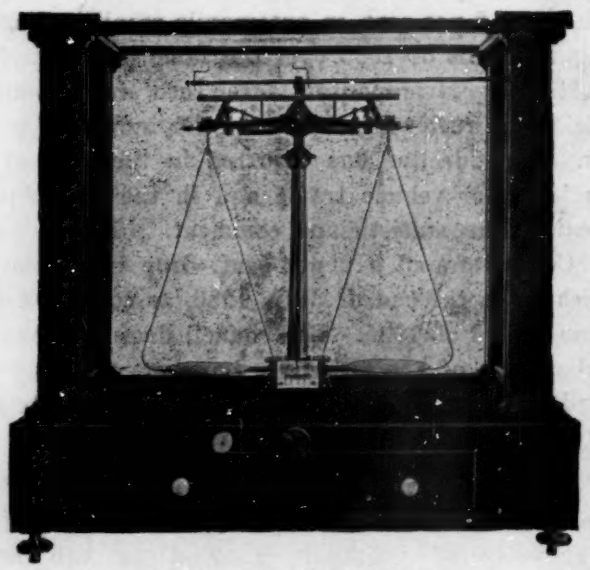

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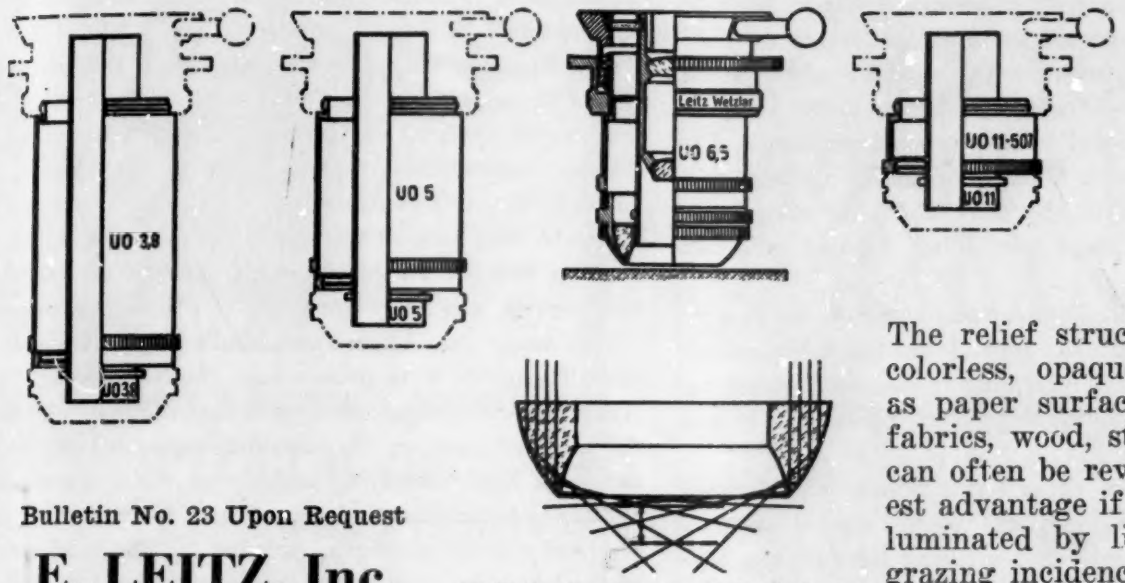

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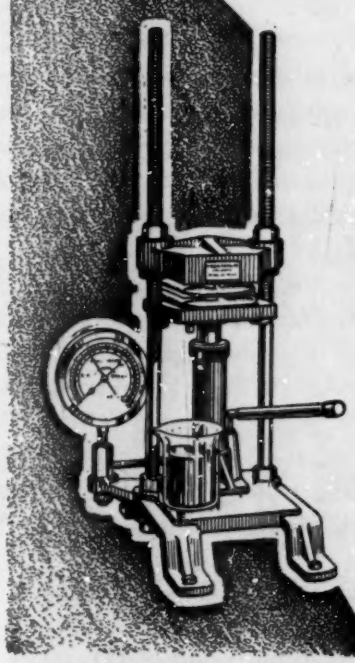

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THE MIND AS AFFECTED BY INTERNAL CONDITIONS OF THE BODY

AN experiment in which Sir Joseph Barcroft, of Cambridge University, England, deliberately froze himself nearly to death was reported by him in a lecture at Yale University. The experiment was part of a study to learn how the human mind is affected by changes in the internal environment of the body. In similar experiments Sir Joseph stayed in a room filled with deadly hydrocyanic acid gas until a dog with him died, and later stayed for twenty minutes in a room containing 7.2 per cent. of carbon dioxide gas.

Man's intellectual development and motility, Sir Joseph pointed out in his lecture, depend on the temperature and other factors of his internal environment remaining constant. As little as one degree of fever affects the mental processes.

"In each of the two experiments which I performed there was a moment when my whole mental outlook altered," Sir Joseph said in describing his feelings during near-freezing. "As I lay naked in the cold room I had been shivering and my limbs had been flexed in a sort of effort to huddle up, and I had been very conscious of the cold. Then a moment came when I stretched out my legs; the sense of coldness passed away and it was succeeded by a beautiful feeling of warmth; the word 'bask' most fitly describes my condition: I was basking in the cold.

"Up to the point at which shivering ceased, nature fought the situation; my instinct was to be up and about, an effort of will was necessary to remain the subject of the experiment; after that point I gladly acquiesced, initiative had gone. Doubtless a second and more advanced stage would follow in which inertia would lapse into unconsciousness. For I suppose that, had the experiment not ended at that point, my temperature would have fallen rapidly and I was on the verge of the condition of travelers when they go to sleep in extreme cold never again to awake.

"And I was conscious of other reversions of mental state: not only was there a physical extension of the limbs, but with it came a change in the general mental attitude. The natural apprehension lest some person alien to the experiment should enter the room and find me quite unclad disappeared."

Sir Joseph concluded from these experiments that the most immediate effect of interference with the chemical or physical properties of the blood is impairment of the higher qualities of the mind. "The thoughts of the human mind," he said, "its power to solve differential equations, or to appreciate exquisite music, involve some physical or chemical pattern, which would be blurred in a milieu itself undergoing violent disturbances."

A LARGE SKULL FROM THE ALEUTIAN ISLANDS

DR. ALEŠ HRDLIČKA, of the Smithsonian Institution, reports the discovery by his expedition to Alaska, of a large skull belonging to a man who lived hundreds of years ago. The skull, belonging to a man of the Aleutian Islands, is shaped to hold a brain of fully 2,005 cubic centimeters. The average man has a brain of 1,450 cubic centimeters. A woman averages about 1,250 to 1,300.

Dr. Hrdlička makes a comparison of this with other brains on record. Daniel Webster is credited with having the largest head of any American within historic times. But his massive brain was smaller than the Aleut's, being about 2,000 cubic centimeters. Bismarck's brain is estimated to have been about 1,965; Beethoven's, 1,750. The Russian author, Turgeniev, with a brain of 2,030 cubic centimeters, still holds the world record in this respect.

The newly found American skull, only a trifle smaller than Turgeniev's, is pronounced entirely normal by Dr. Hrdlička. Examination showed that the man who carried the massive head on his shoulders was no sufferer from any such head-deforming malady as water on the brain, or the thickened bones of gigantism. He was not a person of great size or strength, judging by the moderate size of the bones for muscle attachments. It is believed probable that he was a man of intelligence as well as in quantity of brain matter.

Dr. Hrdlička explains that there is a rough but definite correlation between brain size and intelligence in normal human beings. Brain size, he points out, is the most essential physical difference between man and beast. In the collection of 16,000 skulls in the U. S. National Museum, which is the largest in the world, the smallest normal adult skull of a human being is capable of holding no more than 910 cubic centimeters of brain. This is close to the edge of the gulf separating man from ape, so far as brain size is concerned.

FORESTRY IN GERMANY

FORESTERS in Germany are trying to undo some of the mistakes their predecessors made. Earlier forestry in that country "split itself in two" over the conflicting interests of softwood timber and deer. The most profitable cash tree crop is spruce, and the past generation of German foresters planted great solid blocks of spruce, even and ordered as the cornstalks in a cornfield—and almost as tightly set. But such closed stands of conifers shade out the underbrush on which deer browse in winter, and of course all tenderer summer herbage as well.

Yet the German people, even the vast majority who never go hunting at all, want to have deer about. So the foresters have maintained a heavy deer population artificially, by feeding hay and giving doles of salt. This is recognized as illogical, but "It's a love affair," said one German forester to Professor Aldo Leopold, of the University of Wisconsin.

To restore something like natural conditions, the present school of German foresters is attempting to build what they call "Dauerwald"—the word translates rather awkwardly as "permanent forest." This is to be a balanced forest, with hardwoods mixed with the "fields" of spruce. The deer find certain hardwood trees

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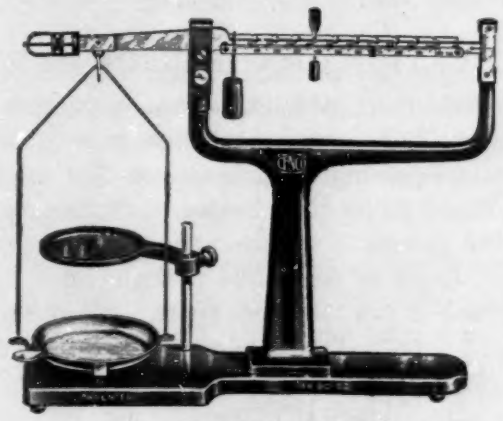

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palatable browse in themselves. Moreover, hardwood growth, unlike the softwood, permits extensive development of the kind of undergrowth that deer prefer to eat—yew, mountain ash, raspberry, blackberry, wild rose.

Professor Leopold believes that American forestry can profitably learn a lesson from the German book, before we repeat the German mistake too extensively. He would have "money-crop" forestry in this country concentrated on the best forest lands, leaving cliffs and rocks to "grow game and scenery."

He would let a reasonable number of predatory animals survive, to act as natural control on game population. He would encourage hardwoods, though keeping pure stands of conifers in obviously profitable places. Finally, he would unify game and forest administration, instead of leaving it in its present troublesome dual-control condition, and he would try to keep the food supply always well above the animal's demands upon it.

CONSERVATION OF THE BISON OF EUROPE

FUNDS from the United States are aiding materially in the effort of German conservationists to save and restore an almost-extinct big animal species that once roamed the Old World as its close cousin, the bison, roamed the New. The species is the wisent, a great, shaggy-maned beast that looks so much like the American bison that only a zoologist can tell them apart. There are at present only 75 pure-bred wisent left in the world, consisting of four small breeding herds and a number of scattered individuals in zoological parks.

Before the World War there were a fair number of wisent, but the war and the revolutions that followed brought about their almost total extermination, until there were only 60 specimens left. These have slowly increased to the present 75.

In a brief discussion of the wisent situation, sent to the official publication of the American Society of Mammalogists, Dr. Theodor G. Ahrens, an American naturalist long resident in Berlin, states that one reason for the very slow increase has been the lack of suitable underbrush for browse in the highly-cultivated German forests.

An effort will be made to overcome this and other drawbacks to wisent breeding at the new wisent park near Munich, in connection with the Hellabrun Zoo. The means for this undertaking were contributed by the New York Zoological Society, to the International Society for the Preservation of the Wisent.

In addition to the propagation of the carefully recorded pure-bred wisent, a second stock of animals is being built up by what is known as "suppression culture." In this, pure-bred wisent bulls are mated with American bison cows, and the hybrid offspring in turn bred back to pure-bred wisent bulls. This is kept up for generation after generation, until there is practically nothing left of the original maternal bison blood.

It is expected that the very slightly hybridized wisent obtained in this manner will finally come to be practically identical with pure-bred wisent in appearance, and that they may very easily be stronger and healthier than the pure-bred stock. Nevertheless, the pure-breds and the "suppression culture" strains will always be kept strictly separate.

A POWER-ALCOHOL PLANT

THE first power alcohol plant in America is producing new fuel for motor cars. Two batches of anhydrous ethyl alcohol made from corn, amounting to 2,000 gallons, have poured from the stills of the Chemical Foundation sponsored plant of the Bailor Manufacturing Company at Atchison, Kans. Officials expressed themselves as pleased with the performance of the new plant and predicted that in a month the capacity of 10,000 gallons a day would be realized.

Alcohol-blended gasoline under the name of agrol will be on sale shortly in seven midwestern states at prices that will compete on a quality basis with straight gasoline fuels. The production of power alcohol from surplus farm products in this plant is being watched by leaders in agriculture, the oil industry and other fields, including government, because it is a practical demonstration of the thesis of the Farm Chemurgic Council that crops from American soil can be utilized for the manufacture of industrial materials.

The Atchison plant produces butyl as well as ethyl alcohol and as a valuable by-product evaporates the spent mash into a protein feed for stock. The butyl alcohol is used in connection with the ethyl alcohol production. The ethyl alcohol is blended with gasoline to produce motor fuel. The whole output of the Bailor plant is being taken by the Chemical Foundation of Kansas for distribution at a price not to exceed 25 cents a gallon.

At the plant the alcohol is denatured and then blended with an equal volume of a petroleum to make what is called "agrol fluid." This blend will be used by filling station operators to make three grades of agrol gasoline, known as agrol 5, agrol 10 and agrol 15. These numbers indicate the quantity of alcohol in each of the standard blends when 60 octane gasoline is taken as the base fuel. If the filling station uses higher octane gasoline, less agrol fluid is needed, and if lower octane gasoline is the base, more agrol fluid is blended.

The oil industry is watching closely the operation of the new plant and the distribution experience. In an article in the current *Oil and Gas Journal*, W. T. Ziegenhain tells how the economies of power alcohol-gasoline blends will work out. The anti-knock value of base fuel, he explains, is raised one number for each one per cent. of alcohol added to the 60 octane base fuel. Mr. Ziegenhain explains how an Omaha distributor might figure his relative cost. He pays 25 cents a gallon for the alcohol at the Atchison plant in the form of agrol fluid, and adds one cent freight charge. The present delivered cost of 60-octane refinery gasoline at Omaha is about seven and a quarter cents. If nine parts of this fuel are blended with one of alcohol, the resulting 70 octane blend costs nine and one eighth cents. Regular 70 octane refinery gasoline is selling at Omaha for about eight and one half cents. Large quantities of gum-solvent refinery gasoline is selling in the same area for one cent premium. The alcohol blend would fall in this classification and

Mr. Ziegenhain believes that "the marketer might be attracted to the alcohol blend and the potential composition made real." The Atchison plant is believed by its officials to be the only commercial alcohol plant that has attempted to produce both butyl and ethyl alcohols and protein feed commercially in its initial operation.

TUBERCULOSIS IN INDUSTRY

TUBERCULOSIS is the most important disease problem in all industry, from the standpoint of both workers and employers. This assessment of the tuberculosis problem was made by Dr. B. L. Vosburgh, of the General Electric Company, Schenectady, N. Y., at the meeting in Atlantic City on October 8, of the American Association of Industrial Physicians and Surgeons.

In spite of enormous strides made in the control of tuberculosis it is still a serious disease, Dr. Vosburgh explained, because it continues to take a heavy toll particularly in the age groups from 20 to 40 when man's productivity is at its peak. "From both an economic and a public health standpoint it outranks every other contagious disease with the possible exception of syphilis," he said.

The bright side of the picture appeared when Dr. Vosburgh told how the worker who has contracted tuberculosis can be protected from the most disastrous effects of the disease and can be kept in good enough health to go on working at his job.

The important thing is to discover the disease before it has progressed far enough to do irreparable damage. For this Dr. Vosburgh recommended regular examinations and supervision of all industrial workers. By such methods many cases of tuberculosis will be discovered even when the patient does not know he is sick. These are the cases in which the disease may have partially healed spontaneously, but there is always danger of its breaking out in severe form if the worker becomes over tired or works in a dusty atmosphere.

Illustrating this point, Dr. Vosburgh reported the case of a young millwright who pulled with all his might on a rope and then began to have bloody sputum. After five years of compensation, he died at the age of 44. This man had been working with a partially healed tuberculosis for years.

For both the worker whose tuberculosis has healed spontaneously, as discovered by examination, and the worker who has been discharged from a sanatorium with an arrested case of tuberculosis, the paramount thing is to find the proper job. The job that will be easiest is the one such a worker should have. Usually this means the job the man knows most about. He should not be put back at his own job, however, when the work itself was a factor in lighting up the disease in the first place.

ITEMS

A NEW star or nova has burst forth in the constellation of Aquila, the Eagle, the International Astronomical Union's central bureau at the University of Copenhagen has been informed by Nils Tamm at the Kvistaberg Private Observatory in Bro, Sweden. It is now eighth magnitude and not visible to the naked eye. News of its discovery has been cabled to observatories of the world. The brightening of this star takes on added interest because the most famous nova of this century, Nova Aquilae of 1918, was in the same constellation. The nova in Aquila was photographed on the night of September 20 at the Harvard Observatory and evidence that the star is expanding was discovered. On photographic plates, Nova Aquilae was twelfth magnitude on June 22, about tenth magnitude on July 22 and about ninth magnitude on August 17.

A NEW comet was discovered in the constellation of Aquarius in the southern evening sky at the Union Observatory, Johannesburg, South Africa, by Dr. Cyril Jackson on September 20. It is faint and diffuse with no nucleus. Astronomers rate it as twelfth magnitude. News of its discovery is being cabled to observatories by the International Astronomical Union's bureau at the University of Copenhagen. Whether Jackson comet will grow brighter can be determined only when more and later observations are made so that an orbit can be computed. The astronomical position of the new comet is approximately right ascension 23 hours and south declination 12 degrees 47 minutes.

DENYING that alcohol-blended gasoline is losing favor in Germany, Dr. Friedrich Bergius, Nobel chemist and inventor of oil from coal and sugar from wood processes, predicts that "a proper blend of ethyl (grain) alcohol, methyl (wood) alcohol, benzene and gasoline bears promise of supplying the world with the ideal motor fuel for internal combustion engines." Dangerous carbon monoxide in the exhaust gases would be reduced to the vanishing point by this properly blended fuel, Dr. Bergius contended in his statement issued by the Farm Chemurgic Council, protagonists for power alcohol made from farm products. Dr. Bergius explained that the German situation with regard to farm products is now quite different from that in the United States and that there is a smaller surplus of potatoes and other starch and sugar crops from which power alcohol in Germany can be made.

SOARING to a record height of 92,000 feet (17½ miles), a tandem of five balloons carried a sensitive self-recording electroscope to a new altitude record for cosmic ray research, Dr. Robert A. Millikan, of the California Institute of Technology, has reported. The instrument, one of five released early in July at San Antonio, and one of four recovered, obtained a perfect film record of cosmic activity at the extremely high level. The record is the first obtained by an electroscope that shows that ionization in the upper air reaches a definite maximum and returns rapidly to lower values as still higher altitudes are reached. Each electroscope, released by Dr. Millikan, Dr. H. Victor Neher and Dr. S. K. Haynes, was carried aloft by five balloons, and a reward of $6 was offered for the return of each instrument. The instruments, rising to an altitude varying from 55,000 to 92,000 feet, were found between 30 and 100 miles from San Antonio. The balloons were aloft about three hours.

THE SCIENTIFIC MONTHLY

EDITED BY J. McKEEN CATTELL

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SCIENCE NEWS

Science Service, Washington, D. C.

UNITY OF SUBJECT-MATTER OF PHYSICS AND CHEMISTRY

DR. J. C. SLATER, professor of physics at Massachusetts Institute of Technology, speaking at Williams College's Mark Hopkins Centenary Celebration, pointed out that after a century of separation the important sciences of chemistry and physics are once more attaining unity of subject-matter, experimental methods and thought.

Mark Hopkins, fourth and most famous president of Williams College from 1836 to 1872, died in 1887.

A hundred years ago scientific men like Davy and Faraday worked interchangeably in the field of physics and chemistry and called themselves natural philosophers. But in the intervening ten decades the two sciences became separated in thinking, techniques and methods. Now, however, physics is coming to the aid of chemistry to provide more powerful ways of observing matter and in interpreting the structure of matter in terms of the basic laws of nature. Professor Slater added that while the ingenious physical ways of learning chemical secrets of matter are perhaps the more spectacular and the most fruitful in immediate results, it very probably will be the theoretical understanding of the structure of matter that will be the most important.

"The impact of the new physical theory on chemistry," he said, "must lead to a firm set of foundations for a natural philosophy of the future, a philosophy starting from first principles, leading to the explanation of the whole of material nature. Now more than at any past time this seems not like a fanciful hope, but like a quite practicable program, which will surely be carried out in the course of time, if physicists have the perseverance and the opportunity for it. Let us hope that if another celebration similar to this is held a hundred years from now, the theory of the structure of molecules and solids will be a subject completely understood, and that science will have moved on to other fields, probably in the understanding of living matter. For this to happen, physicists must have perseverance; for it is a hard task, and physicists have a way of running to the new and exciting rather than to the solid and rewarding problem. And they must have opportunity to work, unhampered by popular prejudice against science or by lack of support. We can not be sure that they will have these necessary things. But let us greatly hope for it and work for it, for the problems I have spoken of are in the main line of scientific progress, and in one of the main lines of progress of human thought."

DIET IN DIABETES

STARVATION diets in diabetes, which once were an important subject for discussion at meetings of the American Dietetic Association, are now gone and almost forgotten, members of the association happily realized as they listened at their meeting recently to Dr. Elliot P. Joslin of Boston. Dr. Joslin described the modern methods of treating the disease with insulin and the newer protamine insulin which has a more lasting effect than insulin itself.

Full trays are now in order for diabetics, although weighing and measuring must still go on. Insulin controls the disease, allowing the patients to eat heartily by comparison with the old days. Carbohydrates, the sugar and starch foods, are no longer forbidden or reduced to a minimum.

The modern diet in diabetes strikes a fine balance between the patient's disordered sugar-regulating mechanism, his insulin dosage and the fats and carbohydrates in his food. Devising palatable food combinations that meet the requirements of each diabetic patient are only part of the dietitian's job. Education of the patient is another important part and education is also an important feature of the patient's treatment at Dr. Joslin's clinic.

After his diet and insulin requirements have been determined, the patient is taught how to live with his disease and keep it controlled with the aid of periodic check-ups with his physician. In this way, even small children learn to give themselves insulin, to weigh or measure their food for each meal and to select the proper foods for themselves from the family menus. Other non-dietetic measures, such as prevention of infections and fatigue, are also taught.

DIET IN ANEMIA PREVENTION

DR. GEORGE R. MINOT, of the Boston City Hospital, speaking before nutrition experts at the meeting of the American Dietetic Association, in Boston, emphasized the fact that a good diet throughout life will aid in prevention of anemia.

Young maidens who "foolishly feed upon trash" were recognized as particular victims of this weakening malady back in the mid-seventeenth century, Dr. Minot pointed out, but it is only within a few years that medical science has gained a clear recognition of the importance of nutrition in warding off this disease.

Dr. Minot, who shared in the Nobel prize award for discovering a life-saving treatment of pernicious anemia, admitted that wide gaps of knowledge still remain. But it is known, he said, that anemias may arise because the body lacks or can not make available at least three classes of dietary substances. These are iron, vitamin C and a mysterious substance contained abundantly in liver and, to a less degree, in certain other organs. It is this last mysterious substance which, if absent, makes normal blood formation impossible and leads to so-called pernicious forms of anemia.

Important as good diet is in prevention of the anemias, other conditions play a part, Dr. Minot explained. Growth of the individual and physical functions, such as the bearing of children by women, may enhance the deficiency of iron that leads to an anemic condition.

EXPECTATION OF LIFE OF THE WORKING CLASSES

LONGER life for the working classes in this country has been gained during the past quarter of a century as a result of public health activities, according to a report of the Metropolitan Life Insurance Company.

The expectation of life at birth for the industrial policyholders of this company crossed the sixty year mark for the first time in 1935. In 1911 the expectation of life at birth for this class of the population was only 46.63 years, whereas now it is 60.25 years.

Expectation of life at birth for the working classes is now almost as good as for the population as a whole. This is shown by a comparison of the life insurance figures with those of the United States Registration Area. For the whole population, in 1934, life expectation at birth was 60.79 years.

The gain in life expectation of the insured wage earners appears even more striking when compared with urban dwellers rather than with the population as a whole. This is a fairer comparison because the insured wage earners live chiefly in cities. White males of age 10 in the urban area of the United States gained 3.95 years of life from 1910 to 1930, while white male industrial policyholders at the same age gained 6.77 years from 1911–12 to 1930. At the same age white females in the industrial policyholder group gained a year more than those in the urban area of the United States.

The gain in life expectation for the industrial class is all the more striking and encouraging because it was made during a quarter century that included the period of the war, the devastating influenza epidemic of 1918–19 and the economic depression, each of which greatly affected the lives and health of the population. The report points out that "Throughout this quarter century, and in the face of the calamities mentioned, those charged with the administration of our public health activities have maintained a scientific attitude toward their duties. Current discoveries in medicine and sanitary science have been applied as soon as they had demonstrated their worth. The results are undoubtedly reflected in the highly gratifying figures that have been quoted."

ITEMS

THE discovery of a "new star," or nova, in the constellation of Sagittarius was, on October 7, reported to the international astronomical bureau at Copenhagen from Tokyo. It will be called Nova Sagittarii. As it is now sixth magnitude it is easily visible to the unaided eye. News of its discovery has been cabled to observatories throughout the world. The rise of a star from obscurity to brilliance, called a nova, signals a gigantic outburst by the star. The discovery was made on Tuesday (October 6).

AN unusual outburst of light in the bright northern star, Gamma Cassiopeiae, has been reported to the Harvard Observatory by Dr. Nicholas Bobrovnikoff, acting director of Perkins Observatory, Delaware, Ohio. Observed early on October 5 by Dr. Ernest H. Cherrington, Jr., the brightening may have important astronomical consequences. Astronomers throughout America are expected to watch the star. The outburst brought the magnitude of the star from 2.25 to 1.6, although its spectrum, always very peculiar, showed no unusual characteristics. The next morning the star seemed to have returned to normal, temporarily at least, for neither its magnitude nor its spectrum shows any conspicuous deviation from the normal.

A WEEKLY survey of the U. S. Weather Bureau reports that prospects for a good winter wheat crop are promising. Ample rains throughout the winter wheat regions have favored seeding, and much of the crop has already made a good start, furnishing excellent fall pasturage. Rains have been general over the once drought-afflicted West and Midwest, except on the northern Great Plains, where the need is sorest. The greatest improvement was noted in the southern part of the Plains area, centering in Oklahoma.

THE first cosmic ray radio data obtained by tiny balloons of cellophane from a height of about 14 miles have been secured by Dr. T. H. Johnson, of the Bartol Research Foundation of the Franklin Institute, and Dr. Alexander A. McKenzie, of the Carnegie Institution of Washington. The equipment consisted of three balloons tied together which expanded to a 13-foot diameter each when their top altitude was reached. Although the radio data, sent back to earth by short-wave transmitters from the unmanned balloons, have not yet been interpreted a large increase in cosmic ray intensity is noted. This finding, however, was anticipated.

A NEW type high-voltage atom smashing apparatus is now under construction by the department of physics of Stanford University which has tentatively been called the "rumbatron." Choice of this name has been made to distinguish it from the "cyclotron," first developed and used at the University of California by Professor E. O. Lawrence. The rumbatron consists of a cylinder 40 inches in diameter enclosed in a vacuum. Inside the cylinder are a filament and a grid which act like a giant radio tube. Electrical oscillations are set up in the apparatus somewhat similar to the squeals of a radio set except that they have a frequency much too high to be heard by the human ear. When electrons are introduced into the cylinder they are accelerated by the oscillating field and, in present design, will attain energies equivalent to 5,000,000 electron volts for a single trip through the cylinder. If additional energy is needed for experiments on nuclear disintegration the electrons can be sent on two, three or as many trips as necessary. An important difference between the new rumbatron and the better-known cyclotron is that the former uses electrons as the bombarding particles while the cyclotron employs atomic nuclei themselves, which are much heavier.

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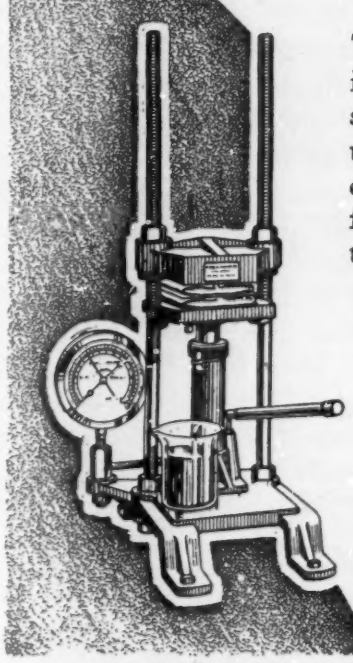

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SCIENCE NEWS

Science Service, Washington, D. C.

HOMES FOR FAMILIES OF LOW INCOME

THE United States lags far behind European countries in providing sanitary, healthy homes for low income families, according to Professor C.-E. A. Winslow, professor of public health at Yale University School of Medicine, who spoke before the American Public Health Association at their meeting in New Orleans on October 15.

Professor Winslow has just returned from a survey of European housing progress. He stated that "The housing of the poor in the United States to-day is at a lower level than that which obtains in any of the leading countries of Western Europe." He urged public health officers to take up the fight for "decent hygienic housing for the American people." He called this new problem the "most important and most challenging" which health authorities have yet been called upon to face.

Endless statistics, he said, show the relation between bad housing and high death rates. Especially significant are the studies made in Liverpool, England, where populations of similar income levels living in slums and in corporation tenements were contrasted. These studies showed that better housing was associated with lower death rates for infants and for tuberculosis and for all causes.

Public health, however, is not satisfied merely with lowering death rates, Professor Winslow pointed out. Health means much more than just staying alive, and that is another reason why health officers must fight for better housing. "Neither physical nor mental health nor fulness of living is possible where a whole family is crowded into a single room of a city tenement or struggles for survival in an insanitary shack on an Appalachian mountainside." Health officers must no longer be content to condemn insanitary buildings and have them destroyed. They must work for the construction of healthy homes which poor people can afford without having to cut down on their food budget.

Professor Winslow said that the new federal agencies, such as the PWA and the Resettlement Administration and others which have in recent years tackled the problem, have "scarcely scratched the surface." "To meet this urgent problem in anything like an adequate manner," he said, "we must have a permanent federal agency for housing and a unified national policy, such as is proposed in the Housing Bill introduced by Senator Robert F. Wagner at the last session of the Congress, which has the support of all competent experts in the field."

When such a policy is adopted, those in charge of the housing program will need the aid of hygienists because the problem is fundamentally one of health needs. He called on those working in public health to be ready to meet this problem as they have in the past met problems such as tuberculosis control, provision of pure milk and safe water and effective health administration.

HOPE FOR CONQUEST OF NEW DISEASES

PREVENTION or control of diseases like infantile paralysis, influenza, and others caused by viruses, may soon be achieved as a result of recent research. This optimistic opinion was expressed by Dr. Ernest W. Goodpasture, of Vanderbilt University Medical School, at the meeting of the American Public Health Association.

"It is not too much to expect very soon," he said, "the introduction into practical prevention of new and more effective methods of control of this great group of infective disorders."

Dr. Goodpasture used as an example of these newer methods the alum-picric acid spray for the prevention of infantile paralysis which was tried out on a large scale during the outbreak of the disease in Tennessee, Alabama and Mississippi this summer. How effective this nasal spray is can not be told at present, but the method is a step in the right direction. He explained that virus diseases can not be fought in the same way as diseases caused by bacteria, such as typhoid fever and diphtheria. Investigators have been able to fight such diseases successfully by sending reenforcements to the body's own disease fighters, the antibodies produced by body cells in response to bacterial invasion. This is the strategy of vaccination, serum treatments and the like. The fight against virus diseases will have to be advanced by chemical warfare.

The reason is that the virus takes a different line of attack from bacteria. The viruses, whether they are living or not, can only multiply and cause disease when they get inside the cells of the body. This is true of some bacteria, but many of them can live and multiply as well between the cells as inside them. Many viruses, in addition to requiring the environment within the cells for multiplication, have a special predilection for nerve cells. This means that in the cases of infantile paralysis, for instance, the virus enters the nerve cells without ever coming in contact with the fluid between the cells that contains the body's disease-fighting antibodies.

This is where the chemical warfare may prove effective. The alum-picric acid spray is designed to create a barrier through which the virus can not pass into the nerve cells. Another piece of chemical strategy suggested by Dr. Goodpasture would be to inject into the body chemicals that would make the nerve cells unsuitable for the growth of viruses once they got in.

JANE STAFFORD

LIFE GIVEN TO MUSEUM GROUPS OF BIRDS

BIRDS and beasts in museums need no longer stand silent and still, as if suddenly frozen in their otherwise lifelike attitudes. Using a unique combination of sound films and ingeniously contrived electrically driven mechanisms, Professor A. A. Allen, of Cornell University, has built two bird groups that sing and go through natural, lifelike movements. Before the meeting of the American

Ornithological Union in Pittsburgh, on October 15, he told how he "brings 'em back to life."

One of his new groups shows a nesting scene of a pair of ruffed grouse in a realistically constructed bit of New York woodland. You turn the switch, the strutting male moves his head and utters his characteristic hissing note, while the female moves to her nest and covers her eggs. In the trees and bushes near-by, thrushes and a song sparrow break into song, an owl hoots, a pileated woodpecker calls out and ducks into his hole and a flicker throws chips of wood out of a nest he is chiseling into a tree trunk. Overhead, a wedge of wild geese honks as it flies away.

Even more striking is the group of ivory-billed woodpeckers, a Southern species now almost extinct. On a recent expedition into the Gulf Coast region, Professor Allen got sound movies of this bird. But because of its great scarcity, it is now an ornithological mortal sin to shoot even a single specimen. However, there was a way out. Professor Allen found a pair of specimens collected many years ago, and mounted in the awkward fashion typical of "stuffed" birds of the mid-Victorian era. He softened up these skins, re-mounted them in the new type of display background and combined them with the new sound effects.

These long-dead woodpeckers now call out with the voices of their remote grandchildren! Even should this species now unfortunately pass completely out of existence, it will be possible for many years for students and bird lovers to watch them in their natural behavior and hear their voices.

Sounds from earth's silent continent, Antarctica, greeted the students of bird life as the opening session got under way. One of the features of the day's program was a sound motion picture of the bird life of Little America, taken by scientists accompanying the Second Byrd Antarctic Expedition.

Only eight kinds of birds starred in this talkie, or perhaps more accurately "squawkie"—for flute-like notes are conspicuously absent, in Antarctica. That is all there are—only eight species of birds. They include of course the inevitable penguins, and the rest are all fishermen in feathers, too. The sound camera caught them all, and to-day they performed and "sang" for an American scientific audience.

In marked contrast to the stark bleakness of the Ultimate South, with its small bird fauna, was the record brought back from New Guinea by Dr. Ernst Mayr, of the American Museum of Natural History. Dr. Mayr's record was also in motion pictures, but they displayed some of the richest, greenest tropical forests in the world, populated with birds of even greater variety and richer coloring than the leaves and flowers of the trees themselves.

FRANK THONE

USEFUL FARM WASTES

CHEMISTS will turn millions of tons of waste farm products into useful materials for industry that will put additional cash money into farmers' pocketbooks, Dr. Henry G. Knight, chief of the U. S. Department of Agriculture's Bureau of Chemistry and Soils, predicted on October 12 before the opening session of the Southern Chemurgic Conference meeting in Lafayette, La., provided they are given the opportunity to conduct the necessary research.

Dr. Knight pointed to millions of dollars added to the agricultural income through science-taught utilization of lemon and orange culls, cotton seed, sweet potatoes and naval stores, such as rosin. "The total production of cellulose on all the farms of the country amounts to something like 100 million tons a year," Dr. Knight explained. "Its utilization in the form of paper, building board, insulating material and absorbent material, as well as its conversion into foods, drugs, paints, varnishes, lacquers, dyes and cosmetics is an inviting field of research that many chemists would like to explore if they had the money and time."

Every pound of grain means one to two and one half pounds of stalks and husks as by-products, while cotton, rice, peanuts and sirup also mean stalks, husks and hulls upon which farmers have expended soil fertility, labor and capital, he said. The old method of using stalks, hulls and culls for livestock feed and building up soil fertility does not provide a cash income for the farmer and for that reason processing of farm wastes into products of cash value is very desirable.

The hundred million tons of cellulose are only part of the chemical constituents of farm by-products. Southern stalks and hulls are about 40 per cent. cellulose, 30 per cent. lignin and 30 per cent. semi-cellulose. Use of starch as a fuel for running automobiles and other engines was hinted by Dr. Knight in discussing the research undertaken by the U. S. Department of Agriculture, which has made possible the conversion of sweet potatoes into a high grade starch for textile use. Germany has already demonstrated starch as auto fuel. Referring to recent estimates that the world's oil supply would probably be exhausted in another 20 years, Dr. Knight said: "What seems impossible to-day often becomes a reality to-morrow, especially in times of war and other emergencies, and it is well for us to work out these chemical problems as we can and keep them on record for the future if they are not practical under existing conditions."

WATSON DAVIS

TRAFFIC SAFETY ON HIGHWAYS

MODERN highway engineers are yet unable to build an absolutely safe and fool-proof road, but that much can be done to build safety into highways was pointed out by Walter V. Buck before the meeting, on October 15 in Pittsburgh, of the American Society of Civil Engineers. Mr. Buck is senior highway engineer of the U. S. Bureau of Public Roads, Columbus, Ohio.

Improved motor design, said Mr. Buck, has increased the confidence of the user in higher speeds and on the highways, as in other forms of transport, the speeds of travel are steadily increasing. You can not stop this speed trend by ignoring it in road design, Mr. Buck intimated, nor can acceptance of the fact be considered an encouragement of speeding. Rather the plan should be

to use the fact of increased speed in future highway designs. Curves should be banked to take speedy vehicles and too much bank is less objectionable to a slow driver than is a curve with too little bank dangerous to a fast driver. While a fast car on a low-banked curve may not run off the curve, the driver may have to go into the oncoming lanes to negotiate the bend, with all its accompanying hazard to traffic safety.

With modern private cars grades no longer have their former major importance, but where a highway has much truck travel the problem of traffic jams behind a slow-moving commercial vehicle is a serious menace.

Little appreciated by the layman, Mr. Buck indicated, is the importance of adequate sight distance on a highway. Sight distance is the length of road which can be clearly seen by a driver at any time and is the distance which allows the driver to determine when and where to pass the vehicle ahead of time. For two-lane and four-lane roads, recommended Mr. Buck, 1,000-foot sight distance is needed. For the more dangerous three-lane highway, 1,500 feet should be in view wherever possible. Each lane on a road should be 10 feet wide, but because most motorists will not drive over near the road edge 11 feet is much to be preferred.

In the vicinity of schools and public buildings near villages and cities surfaced sidewalks should be provided for pedestrians. It should be clearly recognized that the ordinary individual will walk on a dangerous paved highway rather than on a loosely graveled walk.

Improper sight distance on a highway makes the motorist drive "blind" as he would at night with poor headlights, said H. D. Barnes, State Highway Engineer of Topeka, Kans., in discussing Mr. Buck's report. Too much emphasis on the need for a 1,000-foot sight distance can not be made. Three-lane roads are based on a theory which is completely erroneous, for head-on collisions are invited on such roads. The trouble is that each driver who cuts out into the center lane to pass another car feels that he has a right to that area.

Mr. Barnes suggested that even on a two-lane highway a low and smooth central raised portion would help separate the two streams of traffic. Such a central raised part would not prevent cars from passing, but would encourage cars to stay in their own lanes at all other times.

ITEMS

OAT hulls and other farm wastes may in future yield powerful antiseptics for use in medicine and for combating plant diseases, as they already supply industry with materials for making plastic products such as steering wheels, radio panels and electric insulators. Drs. N. M. Phatak and C. D. Leake, of the University of California Medical School, have combined furan, an oat-hull derivative, with mercury in various ways, producing a number of promising germ-killing compounds. In dilutions of e part of antiseptic in from 15,000 to 30,000 parts of water, they killed test cultures of colon bacilli and the yellow germs that cause boils.

THE Hungary correspondent has reported to the American Chemical Society a new patent wherein the seeds of valuable plants can be separated from weeds by magnetic attraction. Separating the seeds of plantain from the valuable ones of Trifolium is an example. A mixture of magnesium or calcium chloride, calcium oxide and iron powder are dusted over the mixed seeds. The chemical agents are adsorbed on the plantain seeds and they are attracted to magnets. Thus the Trifolium seeds are left alone.

A NEW cellulose enamel is on the market in Germany under the trade name of "Emailliola" which is said to be insoluble in water, benzine, benzol, alcohol, turpentine and acetone, according to the report of Trade Commissioner R. M. Stephenson, at Berlin, to the Department of Commerce. The material is highly resistant to weathering, acids, alkalies and mechanical rubbing. It is non-inflammable and can be applied to wood, paper, pulp, cellulose, metals, glass, tile, stone and plaster.

ONE gallon per hour is the water loss of a medium size Anjou pear tree during a hot night. In the day's warmer hours, the loss may mount to eight gallons an hour. These figures are announced by the U. S. Department of Agriculture in connection with a warning that Anjou pear trees showing the effects of water shortage will need thinning both as to fruit and also leaves. The medium size tree has more than 1,000 square feet of leaf area, counting the upper surface of the leaf only.

PLANTS had their troubles in the days of the dinosaurs no less than to-day, a fossil fungus disease described by Drs. M. A. Chrysler and C. M. Haenseler shows. Leaves of a cycad found in a lignite formation of an ancient New Jersey bog were found infested with the feeding threads of the parasitic plant, which could be clearly seen and photographed in microscopic sections. The find, which dates from the Cretaceous period a hundred million years ago, is described and pictured in the *American Journal of Botany*.

THE secret of why the picric acid-sodium alum nasal spray can protect monkeys and, perhaps, human children against infantile paralysis lies in its ability to coagulate protein, just as acid curdles milk. Experiments showing that it is probably this coagulation process which gives the spray its effectiveness are described by Drs. Charles Armstrong and W. T. Harrison, of the U. S. Public Health Service, National Institute of Health, in the current issue of *Public Health Reports*. The membranes that line the nose and the mucous secretions that coat these membranes are protein in character. The spray presumably coagulates these proteins, making a tough coating something like the clot of well curdled milk or like hard cooked egg white. The infantile paralysis virus, it is thought, can not get through this coating and so can not reach the olfactory nerve by means of which it ordinarily reaches the nerve centers where it does its damage.

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SCIENCE NEWS

Science Service, Washington, D. C.

TEMPERATURE OF THE INTERIOR OF THE EARTH

THE interior of the earth has cooled very little in the two billion years or so of the planet's existence. This was brought out in a lecture by Dr. L. H. Adams, of the Carnegie Institution of Washington, on October 27.

Yet in spite of its terrifically high temperature (well over 5,000 degrees Fahrenheit) the middle of the earth is not molten, as men once thought it was. It is prevented from melting because of the tremendous pressure, which at the center mounts to the unimaginable figure of 47,000,000 pounds per square inch.

The earth is made up of three concentric parts, like a baseball. At the center, corresponding to the rubber core of the baseball, is a core having the density of iron, and probably actually composed of iron or iron-nickel. This enormous mass of metal is plastic rather than rigid, and it is non-magnetic, so that it has no influence on terrestrial magnetic fields.

Next, in position comparable to the baseball's string winding, is an intermediate layer composed mainly of magnesium and silica in a chemical combination known to petrologists as olivine rock. Although this rock makes up the bulk of the planet's substance, very little of it is found at the surface.

Finally, there is a relatively thin outer layer or crust, corresponding to the horsehide cover on the ball. This crust is itself double, consisting mainly of granite on the outside, underlain with basalt.

Many methods are used by geophysicists and geologists in getting at the secrets of the earth's interior. Mountain ranges and deep canyons yield direct observational data on the outermost few thousand feet. Eruptive material from volcanoes gives samples from a little deeper down. Inferences can be drawn from the analysis of iron and stone meteorites, which are sometimes thought of as the shattered fragments of an older planetary system, and which in any case probably fairly represent the stuff the solar system in general is made of.

Of especial value are the records of earthquake waves as recorded on distant seismographs. The rate at which they come through the earth, and the apparent paths they take, permit legitimate inferences regarding the kinds of material they traverse and the physical states in which these materials exist.

FATIGUE IN METALS

How science is studying the x-ray "fingerprints" of metals in the hope of being able to forecast the failure of airplane propellers and other metal structures was described at the meeting on October 21 of the American Society of Metals at Cleveland, by Dr. Charles S. Barrett, of the department of metallury of the Carnegie Institute of Technology at Pittsburgh. Dr. Barrett explained that within limits, it is now possible to examine by x-rays a piece of metal suspected of fatigue and possible impending failure, and obtain some idea of the internal damage which has already occurred in it. A specimen piece of metal from an airplane propeller (for example) is placed in front of an x-ray tube and the piercing x-radiation passed through it. The little metal crystals bend the x-rays into a design named the Laue pattern after their famous European discoverer. The pattern, characteristic for each metal, looks like rings of tiny spots arranged in circles with somewhat the appearance of three rings.

Fresh new metal, which has never been stressed in actual use, shows one kind of Laue x-ray pattern and a similar piece of the metal, except that it has been in use, will show a slightly different pattern. This change in the x-ray "fingerprints" of metals with age is quite different from what happened to human fingerprints. From infancy to old age the pattern of fingerprints remains unchanged, and this is the basis of their use in identification and police work.

Where it is possible to have test samples of metal in the laboratory and have on record an x-ray pattern for varying lengths of metal life and fatigue, the state of another piece of metal can be compared roughly. In theory at least, if a piece of metal broke after 2,000,000 flexings with a load of 29,000 pounds to the square inch, and showed a characteristic pattern, it would be possible to tell roughly how near another piece of similar metal—used in an airplane propeller—might be to fracture and failure. Dr. Barrett pointed out that it is necessary to have some idea of the past history of the metal under examination.

RECENT ADVANCES IN PHYSICAL SCIENCE

AT the meeting of the physicists in New York City on October 29 and 30, which celebrates the fifth anniversary of the founding of the American Institute of Physics, atoms and atomic nuclei have a major share of attention on the complicated technical program. But the ways in which the apparently abstract science of physics touches the layman through its applications is receiving special emphasis.

Here are some of the things which physics has done in the five years since the Institute of Physics was created by the founding societies—the American Physical Society, the Acoustical Society of America, the Optical Society of America, the Society of Rheology and the American Association of Physics Teachers:

(1) The ancient alchemist's dream of converting one element into another by transmutation has been abundantly realized.

(2) Artificial radioactive materials have been made available which rival and even excel costly radium in the radiation which they produce. Machines which make this possible have directly brought about a drastic cut in the once-exorbitant price of natural radium.

(3) Studies in aerodynamics and the nature of light alloys have improved both speed and safety of air transport. Radio advances have brought the radio beam navigation to aviation.

(4) Studies in streamlining and the use of light metals have revived the railroads and brought the high-speed, light-weight trains.

(5) In water transport the use of infra-red beams enables navigators, for the first time, to penetrate the baffling problem of fog.

(6) Public health has been improved by studies of air contamination with city dusts.

(7) Refrigeration and heat insulation have aided health in quick freezing of foods and methods of vaccuum packing.

(8) Television has been brought to the threshold of accomplishment; economic problems are now more troublesome in this field than are the experimental difficulties.

WASTE PRODUCTS FROM PAPER MILLS AS FERTILIZER

LARGE-SCALE agricultural uses may be found for one of the most abundant and troublesome of industrial waste products, sulphite liquor from paper mills, as the result of investigations conducted in the U. S. Department of Agriculture by Dr. M. Phillips, M. J. Goss, B. E. Brown and F. R. Reid.

They found that by adding ammonia to either the sulphite liquor itself or to the dried residue left by its evaporation, and heating for several hours at the relatively high temperature of 220 degrees Centigrade, a nitrogen-containing product was formed that had fairly good properties as a fertilizer and soil conditioner. The ammoniated sulphate waste, however, does not produce as marked growth stimulation on test plants as did other crude fertilizers, such as cottonseed meal and dried blood. Sulphite liquor is the result of chemical treatment of wood, to dissolve out lignin, which is undesirable in paper-making, and leave the pure cellulose. The lignin, plus a number of other compounds which also come out in the liquor, constitutes about 50 per cent. of the total bulk of the wood. Yet the sulphite liquor containing it has continued to be a waste product, polluting the streams into which it is emptied.

Lignin is now considered to be one of the chief constituents of humus, the stuff that makes rich soils black, and renders them physically well suited for the growing of plants. Previous attempts to use sulphite liquor as a means for introducing lignin into soils needing humus have failed, principally because the raw liquor is poisonous to plants. But after ammoniation by the new process, it was found to be non-poisonous, and of at least moderate value as a fertilizer.

THE ISOLATION OF THE VITAMIN D

MARKED progress toward the isolation of natural vitamin D, an accomplishment that would be of incalculable value toward a better understanding of body processes, was reported to the meeting of the American Dietetic Association, at Boston, by Professor John W. M. Bunker, of the Massachusetts Institute of Technology. The work was done with the aid of short-wave radio.

This vitamin, best known for its ability to prevent and cure rickets, has been recognized for fifteen years but it has not been possible to obtain it in a state which is beyond all doubt free of contaminating and associated substances.

Working with Dr. Nicholas A. Miles, also of the institute, Dr. Bunker has been able to purify and concentrate a fish oil with the exceptionally high potency of ten million units per gram. Ordinary cod-liver oil, the most familiar source of the vitamin, has only two hundred and fifty units per gram, while even the best known commercial grades have only eight hundred and fifty units per gram.

Reporting attempts at the synthetic production of an antirachitic substance, Dr. Bunker stated that he and his associates have prepared a potent vitamin of this type by radio, as it were, utilizing the electromagnetic force of a short-wave radio to activate irradiated ergosterol, a less concentrated form of the vitamin.

From experiments with this and other derivatives, Dr. Bunker has concluded that there may be a multiplicity of antirachitic substances, each different from the other. These would include, he said, the natural vitamin D of fish liver oil; substances of the irradiated ergosterol type; irradiated cholesterol, another derivative, and a fatty acid fraction of milk.

There are still other rickets-preventing factors in the diet, Dr. Bunker said. The relation of phosphorous to calcium, for instance, is important, and so is casein. This is the principal protein in milk. Casein protects against rickets when it is the only protein in a diet which by all classical criteria should result in rickets. This holds good even when the imbalance between calcium and phosphorous is as great as eight to one and despite the use of the most rigorous purified casein obtainable.

PATENTS OF PLANTS

DESPITE the fact that over 200 plant patents have been granted by the U. S. Patent Office since such patents on flowers, fruits and vegetables became legal in 1930, the field of patented plants is virtually untouched.

Material prepared in connection with the coming Centennial Celebration of the American Patent System on November 23, shows this fact as a logical conclusion.

Here are some of the future possibilities of the effect of plant patents on everyday life: (1) Forest trees as an annual crop, like oats and potatoes. (2) Oranges and bananas grown outdoors in Maine. (3) Apples and peaches six inches in diameter. Such apparent fantasies appear remote at the present time, but much less so than the idea of the radio or airplane seemed to the old patent examiners in 1836, when the present patent system was just beginning.

Queen Elizabeth, it is disclosed, granted what were virtually the first plant patents—except in name—in the famous monopolies given to favored individuals for exclusive rights to flax, hemp, currants and medicinal and dye plants.

In the early American colonies monopolies of any form were extremely unpopular. Most of all, dislike was centered on any plant which was considered the gift of nature

for all to use as they liked. No one, at that time, foresaw possible research and invention aimed primarily at bringing new and different plant forms, intentionally and for profit.

Thus agitation for plant patents continued from 1868 until 1930 before it was finally enacted into law. Here are a few of the patented fruits, flowers and vegetables which you can buy to-day: Apple, apricot, avocado, blackberry, carnation, cherry, chrysanthemum, dahlia, gardenia, gladiolus, grass for gulf greens, grape, grapefruit, peach, pecan, plum, rose, strawberry and waterlily.

ITEMS

THE earthquake that shook Venice, Italy, on Sunday, October 18, did not register its occurrence on distant seismographs. The sensitive instruments in the United States, Canada and the Pacific area that usually pick up a really severe disturbance anywhere, no matter how distant, showed no trace of it. However, Venice could be really severely damaged by even a minor local earthquake, for the city is a veritable "set-up" for seismic trouble. It stands on a group of low, sandy islands off the coast, and this kind of shifting ground is exactly where an earthquake can play the most mischief. The constant additions to the sand and silt load on the sea bottom, brought down by the Po and the lesser rivers of the Venetian plain, are in themselves contributors to eventual earthquake disturbances. By lightening the load on the land, and increasing it on the sea bottom, they set up strains that in the end find their relief through earthquakes.

PACIFIC COAST winter weather during the coming season is expected by Dr. George F. McEwen, physical oceanographer of the Scripps Institution, to be slightly warmer than average, and from normally to slightly more than normally rainy. For a number of years, Dr. McEwen has been making forecasts for the winter season, based on offshore ocean temperatures and other factors. He has been successful in a high percentage of his forecasts.

AN apparatus making use of an "electric eye" to grade milk according to color was exhibited by Dr. John W. Bartlett, professor of dairy husbandry at Rutgers University, at the meeting of the International Association of Milk Dealers at Atlantic City. The apparatus is expected to help dairymen in their efforts to obtain, by suitable breeding, milk of the popular golden yellow color.

THE remarkable blueness of Crater Lake, in Oregon, is not due to anything dissolved in the water. On the contrary, the water of this lake is unusually pure and free from suspended solid particles, and the lake is unusually deep. The explanation lies in a multiple scattering of the light that falls on it, according to Dr. Edison Pettit, of the Mount Wilson Observatory, who made a study of the lake for the Carnegie Institution of Washington. In the process, the red and other colored rays are largely filtered out, and the blue-violet part of the spectrum comes to dominate.

THE birth rate in the United States continues downward, according to the latest figures analyzed by statisticians of the Metropolitan Life Insurance Company. The 1935 birth rate of 16.8 births per thousand population almost reached the all time low of 16.6 recorded in 1933. The slight rise in 1934 encourage the hope that the long downward trend and the threat of an ultimate declining population might be averted. The latest figures show that the 1934 rise was only a temporary deviation from the general downward trend of the birth rate. Each of 33 states and the District of Columbia, representing over half the country's population, showed a falling birth rate. Nine states which showed increases in 1935 were: Illinois, Michigan, Wisconsin, Arizona, Colorado, Montana, California, Florida and Mississippi. These states make up 21 per cent. of the population of the country. Canada's birth rate is declining even more markedly but this nation can better afford the decline as she has a somewhat higher birth rate than the United States. The Canadian birth rate for 1935 was 20.2 per thousand.

A NEW aid for architectural decoration in the form of a treated marble which reveals its sub-surface beauties and texture is on display in New York City. The product is claimed to be the first and only marble whose color and luminous qualities are the result of scientific selection and processing of the natural stone. It was developed by the Mellon Institute of Industrial Research, Pittsburgh, Pa., for the Vermont Marble Company. The problem set the research workers was to make a study of the calcite crystals, of which marble is composed, with a view to determining the particular type of crystal structure best adapted for transmitting light. This accomplished, the next step was to develop a method for processing the specially selected marble so as to obtain the most artistically satisfying effects of light and color. Six color styles are available: brilliant gold with brown markings, a rich deep red, clouds of soft green on a cream background, alternate bands and bars of green and cream, "sunset shades" crossed by bands of green, and the "light and dark wavy effects in striking contrast with crystal-clear areas of quartz."

A LIGHT-WEIGHT portable device that rings a warning bell or sounds a horn when deadly carbon monoxide gas gets too plentiful in an airplane cabin or cockpit has been perfected by S. H. J. Womack and J. B. Peterson, of the National Bureau of Standards. Recent tests show that very small amounts of the gas, contained in the exhaust of airplane and other engines, may be dangerous, particularly in high-altitude flying. Only five parts in 100,000 of air are permissible at an altitude of 15,000 feet. Earlier carbon monoxide indicators used commercially and by the U. S. Navy were modified and re-designed. The heart of the instrument is a cell containing a granular mixture of manganese dioxide and copper oxide, which changes the carbon monoxide into carbon dioxide with generation of heat. Accurate measurement of heat rise indicates the amount of the gas present. The National Advisory Committee for Aeronautics has made public the results of this research.

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SCIENCE NEWS

Science Service, Washington, D. C.

FUTURE OF THE SCIENCE OF PHYSICS

By Robert D. Potter

Listing the practical advances made possible by the physical discoveries of the x-ray, radioactivity and the electron in the recent past, Dr. Karl T. Compton, president of Massachusetts Institute of Technology, predicted that by the end of the twentieth century the still newer discoveries of research on atomic nuclei may yield comparable advances. Dr. Compton spoke on "What's Ahead in Physics" at the dinner session of the five societies of physics meeting in New York on October 30 to celebrate the formation five years ago of the American Institute of Physics.

"During the past third of a century the discoveries of the electron, the x-ray and radioactivity have together brought about the greatest advances which have ever been made in fundamental knowledge of the physical world and in practical applications of this knowledge to human welfare. These developments will undoubtedly continue. It may very well be that the new fields of knowledge disclosed through exploration of the atomic nucleus may bring about a new set of developments of corresponding importance before this century comes to a close. It is primarily in the groups represented by these five member societies of the American Institute of Physics that those things which are next in physics, some of which we can anticipate and some of which are certainly quite unknown to us, will come to pass."

Dr. Compton pointed out that in predicting the future one can depend only on the achievements of the past and a knowledge of present trends. Of the past he said:

"In the last fifty years physics has exerted a more powerful beneficial influence on the intellectual, economic and social life of the world than has been exerted in a comparable time by any other agency in history. Its influence has far exceeded that of wars, political alignments or social theories.

"This is a striking statement which, if true, discloses an equally striking absurdity, for the public is continually excited about this or that issue of politics, tariffs, codes or international relationships which are of far less human import than the past and future accomplishments in that body of science whose American representatives are meeting here to-day, practically unknown and unnoticed."

As justification of his claim for the past usefulness of physics, Dr. Compton showed that all the many types of engineering, civil, mechanical, radio, motion picture, aeronautical, all spring from the mother science of physics. Moreover, other scientists—astronomers, meteorologists, optometrists and others dealing with instruments—are also basically physicists. The contributions in five decades of these men bring glory to the science of physics and make its value outweigh war and politics in its effects on civilization.

Scientific research is needed on a national scale as much as on the smaller industrial scale, Dr. Compton declared, deploring the shortsightedness of research in the Federal Government agencies caused by lack of appropriations. He said:

"Irrespective of our judgment regarding the justification for large government expenditures to stimulate industry, I think that there would be agreement on the following principle by practically all scientists, engineers and progressive industrialists:

"In national, just as in industrial, expenditures, some substantial portion should be devoted to the attempt to improve the products, processes and methods of the future. Huge expenditures for construction and production only, with no provision for research and development aimed at better construction and new production in the future, are woefully short-sighted. Public policy and future industrial welfare require foundations for the future as well as production of the present."

Dr. Compton suggested that some of the most promising future developments in the usefulness of physics lie in the field of medicine. Medical application of x-rays and radium rays have already aided the treatment of such diseases as cancer. Neutrons, obtained in experiments on nuclear transformation, are now likewise found to have a differential effect on normal and malignant tissues. Moreover, artificial radioactive materials like radioactive sodium offer interesting possibilities for cancer treatment without dangerous after effects.

Use of high-frequency radiation to create artificial fever is another application of physics in medicine which is just now showing its value. There is some temperature above which no known organism can live. Recently it has been found that this temperature is lower for the organisms causing distemper in dogs than it is for the dogs themselves. Raising the temperature of the dogs above the lethal temperature for the distemper organisms frees the animal from the disease. In a similar way syphilis has been cured in monkeys, although in man the two temperatures are so close together that it is difficult to effect a possible cure by this method.

"Very recently, however, an improved technique has been developed which offers great promise for many applications and which consists of raising bodily temperature locally by means of electromagnetically produced high frequency electric currents within the body in the region to be treated while the temperature of the body as a whole is kept within the safe limit by special cooling."

THE JOSIAH WILLARD GIBBS LECTURE

By Robert D. Potter

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Many of the problems of astronomy are so big that they must be mentally simplified before astronomers can even start to try to solve them, declared Dr. Henry Norris Russell, professor of astronomy at Princeton University, at the closing sessions of the five founder societies of the American Institute of Physics. Professor Russell de-

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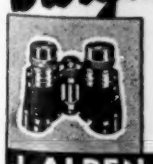

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livered the Josiah Willard Gibbs lecture of the American Mathematical Society on "Model Stars."

To show how astronomers simplify their intricate stellar problems, Professor Russell chose a typical example. "What would happen," he asked, "to a large mass of matter left to itself in space? If we could solve this completely, and work out the special case of our solar system in all detail, we would not have to bother with straw-votes or presidential polls. To get something we can handle mathematically, we must take a single body, forget that it is rotating, and forget that the 90 different kinds of atoms of which it may consist may be present in different proportions in various parts—or, to be polite, assume that the material is 'thoroughly mixed.' The problem can then be solved for a 'cold body' which has lost into space all the heat that could possibly be got out of it.

"For a small body of a cubic mile or less, this would be a lump of rock, ice, or solidified gas. For a very large body, as massive as the sun, the matter would be 'degenerate' and very dense. The atoms would be ionized, or deprived of their outer electrons, by the enormous internal pressure. The white dwarf stars, like the companion of Sirius (which is about 30,000 times as dense as water) represent an approach to being final condition.

"A completely cold body, whatever its mass, can not be larger than a certain size. This has been calculated by the East Indian physicists, Kothari and Majumdar, as 25,000 miles in diameter, for a mass about one two-hundredth that of the sun.

"For a body which still contains internal heat, we do not yet have data enough for an exact solution of the problem. Various assumptions lead to different 'model stars,' all of which are probably like the real stars in some ways, and none of them exactly like them."

The source of the energy which stars are continually pouring into space as radiation is now generally agreed to be caused by transmutation of light hydrogen into heavier elements; with the possibility that the newly-discovered neutrons may also share in a similar building-up process. If only we knew in full the laws which govern this process—or set of processes—we could calculate what the stars ought to be like—if we knew what sort of atoms were present in them, and in what proportions. But we know neither of these things yet.

On many fronts astronomy which studies the gigantic things in the universe—the stars, nebulae and super-galaxies—is therefore waiting, paradoxically with patience and hope, for the nuclear physicist to make discoveries of the most minute things in the universe—atoms, the cores of atoms and electrons.

Can neutrons exist in stellar interiors? There is little hope of solving this question with telescopes. The physicist is more likely to find the solution. "From one standpoint the business of building model stars may be regarded as highly successful. Starting with the most general principles of physics, models have been constructed which closely represent the properties of stars—not of one sort alone, but practically of all types—and satisfy the conditions of stability. The mass-luminosity relation, and the enigmatical white dwarfs have been explained.

"From another aspect, most of the work is still to do. The analytical problems which remain—such as those presented by zones of convection—can probably be solved, approximately at least, by ingenuity in discussion and assiduity in quadratures. But the physical problems still baffle us. From the nature of the situation no unique solution for the law of energy generation can be derived from a study of the properties of stars as a whole, even if these were known with high precision.

"There is a much better chance of being able to deduce the generation law from nuclear physics; but present knowledge indicates that this is likely to depend on the composition of material in a complicated fashion, so that the problems of steady states and possible evolution of the stars, and of the relative proportions and possible transmutations of the elements within them are likely to be intimately connected. We may not live to see the final success; but, when it comes it will enlarge our knowledge of the universe."

PSYCHOLOGICAL ACOUSTICS

PROBABLY without knowing all the reasons why, six professional musicians have been playing selections for scientists at the State University of Iowa to make possible research on the tones of violins. This was brought out by Dr. Paul C. Greene in his report to the New York meeting of the Acoustical Society of America. The purpose of the study was to see if violinists, in unaccompanied performances, played typically in the natural or equally tempered musical scales.

Actually it was found that they played in neither one when their violin tones were turned into electrical currents and made visible on an oscillograph. Musicians will wish to know "that compared with both natural and equally tempered intonation the violinists tended to expand their major seconds and thirds and perfect fourths tended to approximate the theoretical scale values for that interval."

The human ear is able to act as a radio loud speaker, converting the impulses coming in on an ordinary radio set into music, Dr. S. S. Stevens, of the Psychological Laboratory of Harvard University, said in a lecture before the Acoustical Society of America. Although the music can be heard and popular tunes readily identified, the quality is not rich but rather like "tin-pan" music. Nevertheless, there is the advantage that radio advertising is eliminated; speech can be recognized as speech, but only occasional words can be understood.

In Dr. Stevens' experiments, ordinary alternating electric currents were introduced into the ear by means of an electrode placed in the ear filled with a salt water solution. The alternating current was converted into sounds that could be heard. The theory that the basilar membrane of the ear carries a sufficient electric charge so that it is able to respond mechanically to an alternating electrical potential is regarded as a reasonable explanation of this phenomenon.

"We know that the ear behaves as a condenser micro-

phone in the sense that sound energy is transformed into electrical energy. The present hypothesis suggests merely that the ear, like all condenser microphones, is capable of the reverse process of converting electrical into mechanical energy.'' Thus the ear can be both microphone and loud speaker, transforming mechanical energy into electrical impulses and back again into sound.

It is possible for an individual to listen to a tone and then to regulate the frequency of a second tone until it is just half the pitch of the first, according to a report by Dr. Stevens in collaboration with Dr. J. Volkmann, of Harvard, and Dr. E. B. Newman, of Swarthmore College. Although several of those taking part in the experiment declared that the feat was impossible, they all found that they were able to make this judgment of a tone just half as high as another and a numerical scale of psychological pitch was made up in this way. Further experiments indicated that the apparent size of just perceptible increases in pitch remains constant regardless of their location on the scale. This is just the reverse of the way sound intensifiers are heard. The smallest loudness difference that can be perceived depends upon their intensity of the first sound heard.

It would seem that pitch and intensity are not perceived by the same type of physiological mechanism. Loudness appears to depend upon the total number of fibers stimulated in the auditory nerve. Pitch depends upon the location of that stimulation on the basilar membrane. When an individual picks out a tone he feels is just half as high in pitch as another, he picks one that stimulates a portion of the membrane just halfway between that stimulated by the first tone and the end of the membrane.

ITEMS

A BAND of disease fighters at the University of Cincinnati is being specially trained to combat tropical diseases in the event of epidemics imported into the United States by air. While officers of the U. S. Public Health Service are developing new methods of quarantine needed to protect the nation's health since speedy air travel has brought the tropics dangerously close, the department of preventive medicine of the University of Cincinnati is teaching doctors and medical students to diagnose, treat and control tropical diseases, such as yellow fever, malaria and various forms of dysentery. A party of doctors and medical students under the leadership of Dr. T. J. LeBlanc, of the university, has returned from a summer spent in a first-hand study of tropical diseases at the School of Tropical Medicine at San Juan, Puerto Rico.

EVERY state health department should employ a nutritionist to aid and advise the personnel of the health services in small communities, Dr. Wilson G. Smillie, of the Harvard School of Public Health told the American Dietetic Association meeting in Boston. Such dietitians can be of ''inestimable service in recognizing nutritional defects as a factor in health conditions and their influence will often persuade prospective patients to seek advice from physicians.'' Their most important function will be the promotion of normal nutrition through advice in the selection of a well balanced yet economical diet. Larger cities were advised to create an entire department devoted to the efficient solution of nutrition problems. Such a program would be in keeping with the comparatively recent realization of importance of nutrition in preventing disease and promoting general health.

EVIDENCE that plants migrated across the Northern Pacific Ocean nearly 200,000,000 years ago in the epoch of time that geologists call Lower Permian has been unearthed in Texas by Harvard explorers. The discovery of two new species of Tingia, a genus of long extinct plants hitherto unknown in America but found in China, was announced by the Harvard University Botanical Museum where the specimens were studied. Tingia are plants like cycads, a group that flourished for about a hundred million years (during the Mesozoic era) after the age of the discovery just made in Texas. Cycads living to-day in various parts of the world look like palms or ferns, with root-like trunks rising 20 to 60 feet crowned with leaves. ''This new discovery results in a much better understanding of international geological correlations in the Pacific provinces,'' according to Dr. William C. Darrah in commenting on the discovery. The Tingia fossils occur beneath beds in which Gigantopteris plants were found and they were accompanied by plants known as Callipteris and Walchia. Finding the same fossils in both Western America and Eastern Asia is proof that there was free migration of them between the two continents. The party collected other fossil plants from a number of new localities in the Southwest.

LEG-BONES of rats have been grown in the animals' brains by Dr. R. A. Willis, pathologist at Alfred Hospital, in Melbourne, Australia, in an effort to solve a problem of growth and development. Details of the research were reported to the Royal Society. Dr. Willis was interested in what makes bones grow up to be bones. There have been two schools of thought on the subject. One believed that it was the surrounding tissues that made the beginnings of bones in embryonic animals, where those beginnings look like anything but bone, grow into the completed structure. Another held that whatever it is that organizes the primitive cartilage of the embryo into bones was to be found in the cartilage itself. Dr. Willis, confirming the indications of an earlier experimenter who used a different method, proves the second line of thought is correct. He took the one-twenty-fifth-inch-long beginnings of foreleg bones from the very young embryos of rats, and thrust them, by a simple operation, into the brains of adult rats. There, nourished by the surrounding brain tissue, they grew. If it had been the surrounding tissue juices that determine what a tissue shall be, the bones would have changed into brain tissue. This did not occur. The implants grew into almost full-size bones, just as they would normally have done. X-rays and microscope examinations show no difference between these bones grown in the brain, and ordinary bones which grew in the forelegs of rats.

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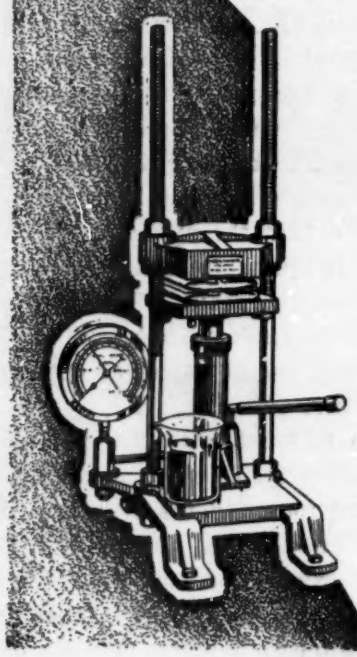

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SCIENCE NEWS

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SOLUTIONS UNDER PRESSURE

THE newest studies of science which have fundamental application in such widely separated fields as the internal composition of the earth, the formation of the igneous rocks in the earth's crust, surface chemistry and important biological problems were described in a lecture given in Washington by Dr. R. E. Gibson, of the Geophysical Laboratory of the Carnegie Institution of Washington.

The emphasis of the research has been on the problem of how chemical mixtures synthesize under high pressure. The effect on the molecular structure of water produced by factors affecting the compressibility and expansion of solutions—as one example—is throwing light on phenomena connected with the solubilities of proteins in saline solutions and touches closely on the vital processes of living organisms.

In the same way a study of chemical building up at high pressure is important to a study of how the rocks in the earth's crust formed from the molten, mixed mass in the dawn of the globe's history. Only by simplification can scientists even begin to attempt the solution of this last problem which coordinates with the three decade study of Carnegie Institution on the nature of the earth in its varied aspects.

Experimental apparatus has been built in the Geophysical Laboratory, which duplicates in some small way the pressures or temperatures encountered in the earth. Temperature can be raised to 4,000 degrees Centigrade or the pressure can be increased to 240,000 pounds to the square inch. Either the high temperature or the high pressure can be obtained; but not simultaneously. With this equipment simple solutions are now being studied, such as methyl alcohol and glycol at room temperature and pressures of 1,000 atmospheres, or 150,000 pounds to the square inch. In studying the effects of high pressures on these simple water solutions, it has been found that the results throw light on the forces between the molecules of the dissolved substance and the fluid which acts as the solvent. It has been learned, for example, that when water is subjected to high pressures its structure is crushed. Some of the intermolecular bonds are broken and the liquid flows more easily than before. The structure of water that can be broken by high pressure consists of the grouping of water molecules into clusters of five, with a central water molecule being surrounded by four others in tetrahedral arrangement.

The much more difficult geological problem that the simple experiments are attempting to solve consists of a liquid mixture of a dozen or so elements, which most chemists have avoided, a mixture which can produce innumerable chemical compounds, all at white heat much above the temperatures usually employed in laboratories and under extreme pressures. An attempt will be made to determine what compounds will crystallize out, and in what order, as the mixture cools.

A NEW MORPHINE

MORPHINE said to be more powerful and safer than the morphine that physicians now use to relieve suffering has been prepared and patented by Dr. Lyndon F. Small, of the University of Virginia. The new kind of morphine —actually Dr. Small has patented three new morphine compounds—was discovered while he was trying to develop a non-habit-forming substitute for morphine. The goal of non-habit-forming morphine is being sought in a fundamental scientific attack on narcotic drug addiction initiated in 1929 by the National Research Council, the U. S. Public Health Service and the Treasury Department's Narcotic Bureau. The research on narcotic substitutes is being carried on at the Universities of Virginia and Michigan.

The new morphines have not yet been tried on human patients. Tests on animals show that they are less poisonous than ordinary morphine; that they are more powerful so that smaller doses can be given; that they act for a longer time, so that they need not be given as often as morphine in the relief of pain. As only animal tests have been made, no statement on the habit-forming possibilities of the new morphines can be made. Another morphine substitute, dihydrodesoxymorphine-D, which Dr. Small prepared two years ago, turned out to be more habit-forming than ordinary morphine, although preliminary tests encouraged the hope that it would be the long-sought non-habit-forming morphine substitute. Clinical tests on human subjects of the new morphines will be made shortly.

The invention comprises three new ethers of morphine and dihydromorphine, in which the alcoholic hydroxyl group of the parent substances (morphine and dihydromorphine) has been etherified: (1) Morphine alcoholic ethyl ether (heterocodethylin or heteroethylmorphine); (2) dihydromorphine alcoholic ethyl ether (dihydroheterocodethylin, heteroethyldihydromorphine); (3) dihydromorphine alcoholic methyl ether (dihydroheterocodeine).

RESEARCH IN CHILD DEVELOPMENT

WHETHER a child's mental development can in the future be watched by means of a study of his brain waves was debated in Washington on October 30 in a special session of the conference of the Society for Research in Child Development. This technique for leading off electric impulses direct from the brain has put a new tool in the hands of those who are studying human minds. These waves come in a certain pattern which is characteristic of each individual. That this pattern may be determined even before birth was indicated by Dr. Hallowell Davis, of Harvard University Medical School. His experiments show a strong suggestion of hereditary or family characteristics. Identical twins show a very close similarity in their brain rhythms.

Dr. Donald B. Lindsley, of Western Reserve University and the Brush Foundation, reported that the significant brain waves do not appear in babies until they are 3 to 6 months old, and then increase gradually from a slow rate of three or four per second until the adult rate of 8 or 10 per second is reached when the child is about ten years old. This finding of a change in rate with develop-

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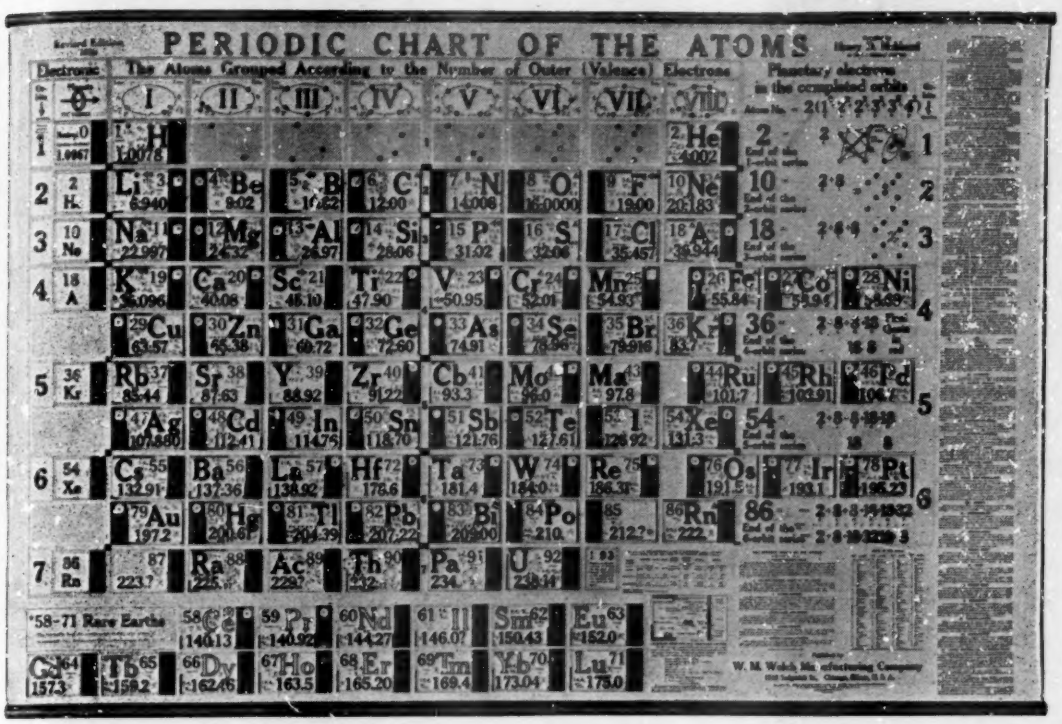

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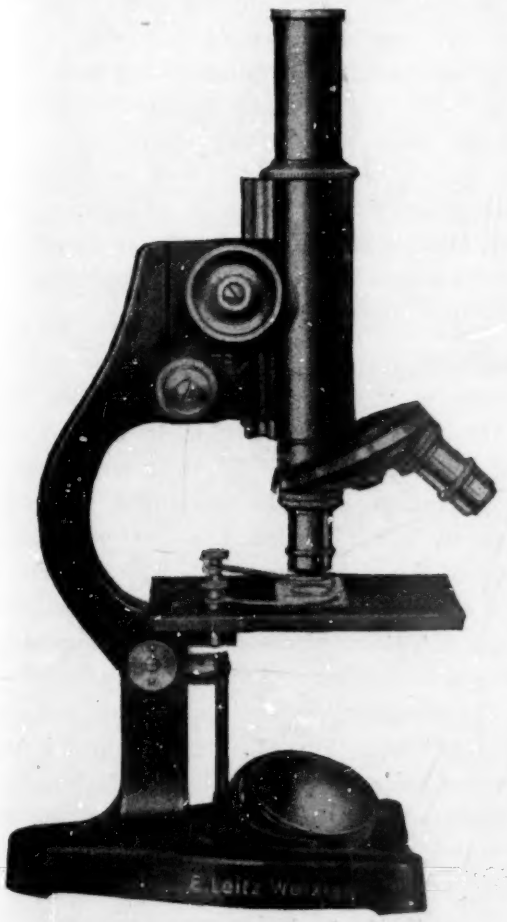

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ment suggests that the brain waves may serve as an index to growth and may in future be used to detect those children who are not developing at their proper speed.

Experiments with guinea-pigs reported by Dr. Leonard Carmichael, of the University of Rochester, were at variance with this finding. Characteristic rhythms are found in the guinea-pig at least twelve days before birth. In the youngest of the unborn animals, the rhythm occurred only in isolated periods with long periods of quiet. But, although the impulses came in a wide range of frequencies from 5 to 40 per second, predominating frequencies from 8 to 12 occurred at all the ages studied.

Dr. George Kreezer, of the Vineland, N. J., Training School, reported peculiar variations of brain waves in mental defectives of the Mongolian type who have mental ages below about 5 years. Because of the extreme sensitivity of the measuring devices used special care must be taken in studying brain waves in order not to be confused by other types of electric impulses.

Dr. T. Wingate Todd, of Western Reserve University and the Brush Foundation, reported that characteristic disturbances of the human digestive apparatus during Lent are not due to the religious fast period itself, but to atmospheric conditions at the approach of the Spring Equinox. Such disturbances are aggravated with stuffy noses near the Autumn Equinox. The effects of emotion as well as weather on the viscera have been studied by means of x-ray examination of the stomach as it digested certain test meals. Both stomach and colon are affected by emotion, but the stomach is more susceptible to momentary emotional upsets while the colon is affected more by long-continued strain. Special sensitivities, such as those which produce hay fever, hives, asthma, eczema and digestive disturbances, have a profound effect on the viscera, particularly the bladder. Most cases of bed-wetting are due in part to such sensitivities. The allergies are linked with both visceral reactivity and the workings of the blood vessels.

Dr. Chester W. Darrow, of the Institute for Juvenile Research, Chicago, recommended use of the so-called lie-detector for the study of children, not as a means of catching the children in lies, but to study their interests, emotional orientation and the situations which cause them mental conflict, Dr. Darrow suggested this technique for studying the electric resistance of the skin and the blood pressure, combined with association tests and special questions.

ITEMS

THOUGH astronomers have no expectation of an unusually fine display, a number of meteors will probably be seen during the night of Sunday, November 15. This is the date of the Leonid shower, when the earth encounters a swarm of these bodies, bits of cosmic dust of pinhead size or smaller. After midnight they may be seen at the rate of about one every minute, instead of one every five minutes which might be seen on other nights. Because the meteors are all moving in parallel paths, the paths of light, which they show when they are burned by friction with the earth's atmosphere, seem to converge in the distance. Since this is towards the constellation of Leo, they are called the Leonid meteors.

DR. MARK ZIEGLER, U. S. Public Health Service regional consultant to southeastern states, has been sent to Georgia to help fight infantile paralysis. The outbreak of the disease is not considered alarming in size, but because numerous cases have continued to occur in Mitchell County, Dr. T. F. Abercrombie, state health officer of Georgia and of the federal health service, requested aid in checking the disease.

THE epicenter of Tokyo's sharp earthquake on Tuesday, November 3, has been checked by American seismologists of the U. S. Coast and Geodetic Survey, on the basis of data collected by wire through Science Service. The point of greatest disturbance was calculated as in latitude 37.5 degrees north, longitude 142 degrees east. The time of origin was 3:45.9 P. M., eastern standard time, or 5:46 A. M., Tokyo time.

THE annual sales of surplus big game animals, including bison and elk, is being conducted by the Biological Survey, U. S. Department of Agriculture. These sales, which have become a more or less regular institution, are required to lighten the load on the various big-game ranges in the West, which can support only herds of definitely determined sizes. If any unsold animals are left after a suitable time, they will be given free to public or private institutions for propagation or exhibition.

A NEW "farthest south" has been reached by the European corn borer during the 1936 season, when the destructive larvae appeared in fields of mainland Virginia, which has hitherto been exempt from their invasion. Although the borer did not extend the western boundary of its territory beyond last year's lines in Michigan and Indiana, its numbers along this boundary increased markedly. This insect thrives best and carries on its invasion most successfully during wet weather. That it has been able to hold its own territorially and increase in numbers during a season of extreme drought is indication that it is ready to push westward rapidly next year if the season is more nearly normal.

ADVOCATES of filtration of public water supplies as against chlorination are called to account by the *Journal* of the American Medical Association in an editorial article. "If safe drinking water is desired, it may be obtained by chlorination. If it is clear water that is wanted, filtration may be employed at somewhat greater expense, but filtration can not guarantee continued safety of the water supply." The editorial makes plain that a community that must depend for its health protection on filtration alone or chlorination alone had better choose chlorination. Any method of water treatment calls for unceasing expert supervision. Failure to prevent the contamination of initially pure ground or surface water supplies and especially the failure to recognize the danger of cross connections between the pipes of the public water supplies and the pipes supplying water for industrial purposes or for fire protection have caused hundreds of outbreaks of water-borne disease.

THE JOURNAL OF COMPARATIVE NEUROLOGY

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Vol. 65 *Contents for December, 1936* **Complete**

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SCIENCE NEWS

Science Service, Washington, D. C.

DISCOVERY OF THE POSITRON

By WATSON DAVIS

Director of Science Service

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THE discovery of one of the building blocks of the universe, the positron, recognized by the award of the Nobel prize in physics to Dr. Carl D. Anderson, of the California Institute of Technology, is one of science's great achievements.

While most things about us seem to be solid, they are in reality made up of widely separated atoms, very tiny particles that in themselves may be thought of as miniature solar systems, consisting largely of open space. Inside the atom are found electrons, protons and possibly other particles.

Electrons have been known and studied for some forty years, ever since Professor J. J. Thomson (now Sir J. J. Thomson) showed that cathode rays consisted of negatively charged particles far smaller than atoms. Dr. R. A. Millikan measured the negative electric charge on these electrons.

Electrons have proved to be nearly omnipresent. They are the stuff of electrical current. Metals are believed to be full of them. They are thought to be responsible for emission, absorption and scattering of light. No atom could be complete without them. The electron is still, despite our changing ideas about the ultimate, a fundamental particle.

In all these years of acquaintance with the negative corpuscle or electron, scientists felt very, very sure that there was no positively charged particle smaller than the proton, which was nearly two thousand times heavier. The first suggestion of a positive electron came from Professor P. A. M. Dirac in 1931, when he put forth his theory of the electron. This prediction of a positive electron made investigators alert to the possibility of finding it in nature. But they did not know where to start to look for it.

The discovery was made in the course of experiments with cosmic rays at the California Institute of Technology. Dr. Carl D. Anderson had set up a Wilson expansion or cloud chamber on its side in such a way that cosmic rays might plow through the greatest possible length. He was photographing the long tracks that the cosmic ray particles leave behind them. An intense magnetic field was used to curve the particles and the amount of curvature gave an indication of the speed and energy with which they were traveling. This investigation was a part of the extensive program of cosmic ray research that Dr. R. A. Millikan had organized. It was not a search for the positive electron.

There was one feature of this expansion chamber, besides the intense magnetic field, that was unusual. Dr. Anderson placed a thin lead plate in it so that the cosmic rays and any particles that might shoot through the chamber would have something to try their energies upon. The Russian, Skobeltzyn, and others had previously watched and photographed cosmic ray cloud tracks, and Drs. Millikan and Anderson had adapted the method because of their hope that it would give information about the nature of cosmic rays.

In 1931, Dr. Anderson found that cosmic rays disrupt atoms of the air and other matter when they plunge earthward. He made photographs that showed particles, writing their paths in water droplets, curving in opposite directions under the magnetic influence, showing that they were oppositely charged with electricity. One such curving track was made, in a pioneer photograph, by an electron of 140 million volts energy. Another was made by a positive particle, which at that time Dr. Anderson guessed was a proton of about 70 million volts energy.

Here were projectiles of much higher power than physicists were in the habit of using in their researches. Here were transmutations on a grand scale of energies. Little wonder that young Anderson gambled harder than ever, risking the exposure of foot after foot of movie film in the hope of catching the atom smashing at exactly the right instant. Only the happenings during a fiftieth of a second could be caught at each try. Since the disrupting of atoms by cosmic rays does not happen every instant, many of the films were blank.

Then came August 2, 1932, and the making of the portrait of one of the most famous particles in all history. It left a water droplet trail five centimeters long even after it plunged through six millimeters of lead. Carefully checking its curvature, inspecting the texture of the trail on the photograph, digging into the Dirac electron theory, Dr. Anderson concluded that the positive electron had been caught. With due caution, he waited until two more similar photographs were obtained and then sent to SCIENCE (September 1, 1932) the announcement of the discovery of the positive electron, a positively charged particle with a mass approximately equal to the ubiquitous negative electron.

He continued to make photographs, slowly accumulating in seven months fifteen photographs of positive electron tracks in a group of thirteen hundred photographs of cosmic ray tracks. Then in February, 1933, news came from Cambridge that in Cavendish Laboratory, the discovery of the positive electron was confirmed. Dr. P. M. S. Blackett and G. Occhialini had arranged their expansion chamber so that the passage of a cosmic ray through the chamber set up electrical impulses in two Geiger counters, one above and the other below the chamber. Only when both counters signaled at the same instant was a photographic plate exposed. The British experimenters found that some of their photographs showed "showers" or bursts of many tracks, all radiating from a single point. It was as though there had been an explosion. In the flying particles were positive electrons. There were ordinary common old-fashioned electrons as well. Dr. Anderson, too, found these showers. In many more cases than can be accounted for by chance,

a negative and a positive electron were found to come from the same point. The significance of this may have important consequences. In giving birth to electron pairs, energy may be turning into matter. But that is another story.

Now that the existence of the positive electron was recognized as the result of work in two laboratories, it was time for it to be christened. Dr. Anderson named the child of the cosmic rays "positron." At the same time, for the sake of uniformity, he suggested that the name of the negative electron be changed to "negatron," but since the electron for forty-odd years has been called by its old name it seems unlikely that scientists will take kindly to the new one. "Positron," since its coining, has been firmly written into the literature and promises to stick.

There was some objection to the disregard of mythology inherent in the word "positron." Professor Herbert Dingle, of Imperial College of Science and Technology in South Kensington, England, suggested the name "oreston" for the new positive particle. This is mythologically correct, for Orestes was the brother of Electra. Other English physicists had in the meantime contributed to the confusion, but not in a serious manner. The discovery of the positive particle came from the cosmic ray tracks that seemed to be bent in the wrong way. Sporting Englishmen immediately thought of cricket and the peculiar hops that the ball takes on bouncing in front of the wicket. These are called "googlies," so the new tracks and thus the particles in laboratory slang became "googlies" also.

PARTICLES IN COSMIC RAYS SIMILAR TO BUT DIFFERENT FROM THE ELECTRON

(Copyright, 1936, by Science Service)

DISCOVERY of an unknown particle that may prove to be as important as the positron was made known by Dr. Carl D. Anderson to his colleagues at the California Institute of Technology just a short time after he was notified of his sharing in the 1936 Nobel physics prize for his discovery of the positron.

Dr. Anderson has found that the cosmic rays include electrical particles which make tracks much like electrons, but are quite different from anything heretofore recognized or investigated. The particles seem to have an unusually great penetrating power and do not readily knock electrons out of matter at the rate equally energetic electrons do.

In many thousands of cosmic ray photographs obtained in Pasadena, Pike's Peak and at Panama, there are many examples of presumably ordinary electrons (the fundamental particle of electricity, negatively charged, discovered years ago) which produce showers of secondary particles as they pass through the apparatus. But there is also another phenomenon, lone tracks that traverse lead plates without producing any perceptible secondary effects. These are the hitherto unknown particles. Dr. Anderson does not venture to guess what the unknown particles might be but he indicated that they probably have the same charge as electrons although not the same mass.

This latest report by Dr. Anderson was received with great and serious interest by his colleagues. He has often produced conclusive proofs for startling results, and he has the reputation for careful interpretation of results. The experiments which led Dr. Anderson gradually to his conclusion were carried out in collaboration with Dr. Seth Nedermeyer and Dr. R. A. Millikan, head of the California Institute of Technology, himself a Nobel laureate.

TESTING UNIT FOR CHECKING MOTOR TRUCK SCALES

INVESTIGATORS at the National Bureau of Standards have come to the aid of state and local communities which are responsible for checking weights and measures. A new motor truck scale testing unit is soon to go on extended tour. It will check the performance of scales that measure loads up to 38,000 pounds.

Millions of dollars in coal and other bulk commodities change hands each week on truck loads of fourteen tons and more. Checking the scales which weigh these loads is almost a completely blank spot in the duty of authorities to prevent fraud in short weight. It is estimated that 90 per cent. of the weights and measures jurisdictions in the nation do not have proper testing equipment to make the frequent tests of the heavy-duty scales being used.

The National Bureau of Standards' new testing unit is designed to demonstrate possible inaccuracies of large scales. It is hoped that when the situation has been made known state legislatures will realize the necessity of duplicating the equipment for their own use. In this sense the coming tour of the giant truck and its fifteen 1,000-pound standard weights will be missionary work designed to improve a serious situation. The trend of recent years to carry larger and larger motor truck loads and the increased volume of truck transportation have spurred the National Bureau of Standards in its development.

R. W. Smith, chief of the bureau's division of weights and measures, explained the operation of the new testing unit to Science Service. A 23,000-pound truck carries the fifteen 1,000-pound standard weights to the scale to be tested. A hoist lowers the 1,000-pound weights singly to one end of the scale platform. The scientists thus check the scale from the range of zero to 15,000 pounds. Then by a small special rubber-tired, two-wheeled cart the weights are transferred to the other end of the scale one by one and the other end checked for the same range. Checking of each end separately is desired since the ordinary scale contains mechanisms at each end which combine to give the total weight. Following this part of the test the weights are removed from the scale and the heavy truck rolled on. The scale is then balanced when its load is around 23,000 pounds. Then the hoist lifts the weights, one at a time, back to the truck and the range from 23,000 to 38,000 pounds is thus checked. The allowable error in a weighing of 40,000 pounds is only 80 pounds, or .2 per cent. Frequent checking is needed on heavy duty truck scales to maintain this accuracy.

AN IMPROVED COTTON PICKER

A MUCH improved, more efficient cotton picker is described in two U. S. patents granted to Mack D. Rust and John D. Rust, of Memphis, Tenn., who have invented a cotton picking machine to do the work of a hundred pickers.

The new machine strips cotton even from the unopened bolls of the cotton plant. It has a "mechanical gleaner" on it, which salvages any dropped cotton. It is more compact so that it can get between narrower rows of cotton plants. It has a device for directing and manipulating the cotton plants so that the picking spindles will strip the plants for the maximum amount of cotton. It can be operated at maximum speeds to suit the type of field being picked. The faster the machine moves the faster the pickers pick. It does not clog up or jam.

Mounted on a tractor, the machine consists of two picking units, one on each side of the operator, so that when the machine moves down the field it covers two rows of plants at a time, picking them simultaneously. Just as the cotton plants enter the throats of the picking units, they are grabbed between the jaws of a boll crusher. This bursts any unopened bolls to expose their fleecy cotton to the picking spindles. Then the plants pass into the tunnels of the pickers proper where a screen cylinder guides them into intimate contact with moist, rapidly whirling spindles, which like hungry fingers, pick the cotton from the bolls. As the tractor continues to move over the rows of cotton, the cotton-laden spindles move out of the tunnel to be stripped of their cargo. While stripped, remoistened spindles take their place. New cotton plants pass into the throat of the tunnel while the picked plants make their exit. To "glean" any cotton that may drop off the pickers there are two separated troughs which pass between the plants. With this new feature, cotton can not spill over on to the ground. Instead it drops into the troughs where conveyors carry it to suction pipes, which suck the cotton up and deposit it in bags.

ITEMS

HIGH-SPEED motion picture photography in aid of industrial chemistry to throw new light on such problems as the fracture of chemical containers under pressure, was discussed at the Baltimore meeting of the American Institute of Chemical Engineers. Using the high-speed motion-picture system developed by Professor Harold E. Edgerton, of Massachusetts Institute of Technology, Dr. Gustavus J. Esselen and Dr. J. G. Hildebrand, consulting chemists of Chicago, filmed the bursting of a bottle under pressure to show where the initial crack formation began its destructive action. In another study the hitherto unseen behavior of a heavy punch press was studied photographically. In the machine the operation is intermittent and of such a character that at one point in the cycle large amounts of energy are suddenly applied for a short space of time. The camera showed that the heavy machine was actually lifted several inches off its base at each cycle, yet this motion had not even been suspected by the operators. In addition, a heavy supporting beam, which the engineers believed incapable of distortion, was flexed several inches every time the energy was applied. Armed with this information, the engineers were able to redesign a machine that would not be subject to unexpected distortions.

FOSSILS of freshwater fish, found abundantly in Tertiary deposits in Alaska, have been brought back by an expedition headed by Dr. Erich Maren Schlaikjer, of Brooklyn College, to be classified and studied at the American Museum of Natural History, New York. The formation where they were found is approximately 30 million years old. Dr. Schlaikjer also brought back a collection of plant fossils from the Alaska Tertiary. Flying over territory as yet unexplored, he saw further deposits which he plans to visit and excavate.

FRESH pork needs more cooking than it gets, if San Franciscans are typical of pork eaters in general. The parasite that lives in the muscles of hogs and pigs and causes the serious disease, trichinosis, has been found in the bodies of almost one-fourth of a series of 200 persons on whom postmortem examinations were performed. Drs. James B. McNaught and Eugene V. Anderson report this discovery in the *Journal* of the American Medical Association. The records of these 200 persons gave no definite history of trichinosis, yet the disease must have been present in its milder forms. In twenty-five autopsies performed on new-born infants the parasite was not found, thus supporting previous medical observations that prenatal trichinosis does not occur. The authors of the article state that "It is impossible to detect infected pork by practical methods of meat inspection. Two out of ten specimens of fresh pork sausage purchased in first-class markets in a heavily patronized shopping district in San Francisco contained living Trichinella. Therefore, under the present methods of meat inspection, it is necessary for the consumer to assume the responsibility of preventing trichinosis by either avoiding or thoroughly cooking all fresh pork."

WEATHER men studying the origins and migrations of air masses may find it necessary to add bacteriology to other techniques. Dr. Claude E. ZoBell and Dr. Helen M. Mathews, of the Scripps Institution of Oceanography, have conducted quantitative studies on the proportions of land and sea bacteria in breezes blowing both off-shore and on-shore. Land breezes carry preponderant numbers of soil bacteria, while breezes from the sea have a higher ratio of saltwater organisms. Not more than five per cent. of soil bacteria can live in a saltwater medium. While a somewhat larger proportion of oceanic bacteria can survive living conditions like those of inland soil, a large ratio of such organisms in an air mass of unknown origin would seem to indicate that it had traveled over the sea. Dr. ZoBell and Dr. Mathews present their results in the *Proceedings* of the National Academy of Sciences.

Four Successful Textbooks

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By EDMUND W. SINNOTT, Barnard College, Columbia University. *McGraw-Hill Publications in the Agricultural and Botanical Sciences.* 525 pages, $3.50

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Shull's—EVOLUTION

By A. FRANKLIN SHULL, University of Michigan. *McGraw-Hill Publications in the Zoölogical Sciences.* 312 pages, $3.00

Here is a readable general treatment of evolution which approaches the subject from the viewpoints of the outdoor naturalist who presents phenomena to be explained, and of the laboratory worker who would interpret them. Since last spring, a score of colleges and universities have adopted the book. *Typical institutions:* University of Alabama, College of the City of New York, University of Illinois, Indiana University, Northwestern University, Stanford University. *Typical comment:* "I am favorably impressed with his presentation of this difficult subject. As it stands, it is the most modern treatment of evolution."—Professor ALFRED F. HUETTNER, New York University.

Holmes's—HUMAN GENETICS AND ITS SOCIAL IMPORT

By S. J. HOLMES, University of California. 414 pages, $3.50

Discusses the basic principles of heredity and what they signify for human biological evolution, differential birth rates, marriage rates and death rates and their evolutionary import. *Typical adoptions:* University of California, University of Michigan, Smith College, Stanford University, Washington State College. *Typical comment:* "I have looked the book over carefully and think it is one of the best works of this sort that I have seen."—Professor E. R. HENRY, New York University.

Wolcott's—ANIMAL BIOLOGY

By the late ROBERT H. WOLCOTT, University of Nebraska. *McGraw-Hill Publications in the Zoölogical Sciences.* 615 pages, $3.50

Combines the "types" and "principles" approaches in a simple and interesting treatment of the whole field of zoölogy. Emphasis is placed upon broad points of view; all topics are adequately treated; the material is carefully and systematically organized; the illustrations are a feature of the book. Eighty colleges and universities have adopted Animal Biology. *Typical institutions:* Colgate University, Cornell University, Dartmouth College, University of Minnesota, Purdue University, Rutgers University. *Typical comment:* "It is an all-round excellent book, soundly planned and well written, illustrated particularly well . . . The students really get their money's worth in this text."—Professor GORDON ALEXANDER, University of Colorado.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE CENTENNIAL CELEBRATION OF THE AMERICAN PATENT SYSTEM

DR. HARRISON E. HOWE, editor of *Industrial and Engineering Chemistry*, opened the centennial celebration of the American patent system. In his address he brought out that the ancient Romans had one of the world's most noted discoveries within their grasp, printing with lead type, yet they never foresaw its usefulness. When visiting the ruins of a palace of a Roman emperor in Rome, one may see a lead pipe, fashioned to convey water to his bath, with letters raised in the lead. But one is unable to explain why, having taken that step, it occurred to no one to smear upon the raised letters a little pigment in some vehicle and press it upon papyrus, metal, wood or textile. Printing from type seemed at the time of such small importance to those engaged in the development that even secrecy was unemployed. Nor did the inventor ever lay claim to his invention, leaving some doubt as to who he actually was. "Gutenberg is ordinarily given the credit, but it is by no means certain that he fully deserves it. But if he did, his reward was only a few lawsuits and a life of debt—far too little incentive to encourage many others to invent."

The 1,000-year depression in inventiveness which marked the Middle Ages might still exist if men had not accidentally stumbled on a way to incite the art of inventing. The need of monarchs for some means of rewarding either deserving or favored henchmen became serious. Destitute rulers were hard pressed to devise suitable rewards for "services rendered" out of their meager purses. They needed all the taxes they could collect and had no more baronies or duchies to give away. The result was that they devised monopolies which were secured to the recipient by proclamation. This proclamation was named a patent.

The abuses under such a system whereby all persons had to pay a sixteenth century "John Doe," a tax on a common material for every food, can be imagined. In the historic "Statute of Monopolies" in 1623, the British Parliament declares all such monopolies illegal except those applied to new manufactures or inventions. Thus on a single exception to a lengthy piece of legislation in antique British law is based the patent systems of the world and there lies the reason why the 1,000 years inventive depression has not extended into the present era.

Thomas Ewing, of New York City, formerly commissioner of patents, spoke on the same program on the American patent system. In its stimulating effects on the mentality of the laboring classes of the nation the American patent system can be compared with the public-school system, which is the most democratic element in America's social structure. While the Constitution was being framed there was, at one time, a provision for the establishment of a national university. This was later dropped and the provision respecting copyrights and patents was inserted. The two operate in much the same way, but the patent system is more democratic because it reaches the artisan class, whereas the class reached by copyright, broadly speaking, is much more limited and is higher in the social scale. The system benefits individuals by making it possible to create property without the employment of capital. Another aspect of the democratic force of the patent system is that it enables the individual or small business man to compete with the great, large industrial companies. The "armor" of big business can be pierced by the "spear-head" of invention.

THE EXACT SHAPE OF THE EARTH

SEEKING more information about the exact shape of the earth, an expedition of the Hydrographic Office of the United States Navy will leave Panama on November 30, on a 6,500-mile cruise in the U. S. submarine *Barracuda*. The expedition, under the auspices of the American Geophysical Union and sponsored by the American Philosophical Society, will explore the waters of the Caribbean Sea for six weeks, investigating the unique geological area off the lower Antilles.

Its scientific personnel includes Dr. Maurice Ewing, geophysicist, Lehigh University; Lieutenant Albert J. Hoskinson, gravity expert, the U. S. Coast and Geodetic Survey, and Dr. Harry H. Hess, of the department of geology of Princeton University. The trip has been planned by Captain Lamar R. Leahy, U. S. N., Navy Department hydrographer, and by a committee of the union on ocean basins and their margins, of which Professor Richard M. Field, of the department of geology of Princeton University, is chairman.

The main objective of the expedition will be a program for measuring the force of gravity in the region where the great West Indian archipelago bends toward South America. This is suspected to be one of the greatest deformations of the earth's crust. Volcanic eruptions and earthquakes are frequent there. Since the variations in the force of gravity are greater in the region of island archipelagoes than anywhere else in the world, it is expected that the data obtained on this expedition will throw important light on many fundamental geological problems.

Among the instruments which will be used in making the investigation is a crystal clock, placed at the disposal of the expedition by the Bell Telephone Laboratories of New York, which is expected to increase the accuracy of the gravity observations beyond that which could be obtained with the chronometer methods formerly employed. A multiple pendulum apparatus, invented and constructed by F. A. Vening Meinesz, of the Netherlands Geodetic Survey, a pioneer in under-water gravity measurements, will also be used.

With the exception of the Netherlands, the United States Navy has led all other nations in this type of scientific investigation, this being the third expedition in which its submarines have been employed. In 1929 the *S21* established 49 gravity stations in the Caribbean Sea and

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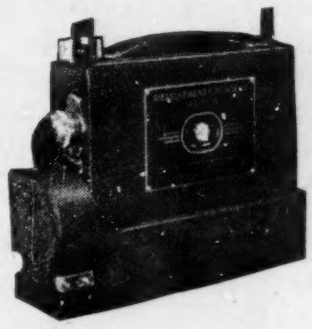

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the Gulf of Mexico, and in 1932 the *S48* made more than 50 in the vicinity of the Bahamas and Cuba. Because the disturbances on the surface of the water, even in calm weather, make operation of the delicate instruments impossible, the submarine is essential in establishing gravity stations. In order to reach sufficiently quiet waters the submarine must be submerged to a depth of 75 feet. To make the gravity readings usually takes about three quarters of an hour. Then the submarine is brought to the surface again and proceeds to the site chosen for the next gravity station, probably from 25 to 75 miles away.

The Navy Hydrographic Office expects to obtain several thousand sonic soundings during the course of the expedition. A large number of soundings will be taken in the unexplored area of the sea bottom east and southeast of the Virgin Islands, where a great deep, similar to the Nares Deep north of Puerto Rico, is thought to exist. During the course of its cruise the expedition will visit Trinidad, Barbados, Martinique, Antigua, St. Christopher and St. Thomas.

A NEW VACCINE FOR YELLOW FEVER

DR. WILBUR A. SAWYER, of the International Health Division of the Rockefeller Foundation, reported to members of the American Society of Tropical Medicine meeting in Baltimore, that a new vaccine against the dreaded yellow jack is expected as a result of isolation of a new, safer strain of yellow fever virus. The vaccine which Dr. Sawyer and associates developed some years ago, and which can only be made in limited amounts, had to be used with serum from blood of individuals immune to the disease as a result of recovery from a previous attack. The new virus, it is expected, can be safely used for vaccination without this protective immune serum. However, vaccination is not yet in the stage where it can be used for entire populations. Protection of a whole country or continent from the disease is being sought by other methods. Recent developments in Brazil have shown that new methods for the control of this dangerous disease must be developed.

Following the discovery by Walter Reed and his associates that the disease is spread by a particular kind of mosquito, and the demonstration by Gorgas in the Panama Canal Zone that anti-mosquito measures could check the disease, it was thought that the disease could be completely wiped out from the face of the earth. Campaigns in one country after another were undertaken, with apparent success. The method was to eliminate mosquito breeding in key locations, the cities and towns and other centers of population. Just as scientists thought they were nearing victory, investigators for the Rockefeller Foundation discovered that the goal was nowhere near in sight. The reason is that a form of yellow fever has been discovered in forest regions of South America. Anti-mosquito measures effective in cities will not work in these forest and jungle regions and new methods will have to be found. A further complication is the discovery that yellow fever can be carried by more than one type of mosquito. The newly discovered yellow fever mosquitoes have different breeding habits and will require new and different methods of control.

—JANE STAFFORD

A MORE DANGEROUS FORM OF MALARIA

DISCUSSIONS before the American Society of Tropical Medicine, in Baltimore, brought out evidence that the kind of malaria now most prevalent is more dangerous and virulent. Malaria, transmitted by mosquitoes, is no minor disease. Thousands of lives are taken each year; with increased virulence the death toll may be greater. It is higher now than it has been at any time since 1929, and the disease is spreading into new areas once free from malaria.

Physicians, health officials and laymen were taken to task for their indifference to this situation by Dr. Henry E. Meleney, of Vanderbilt University School of Medicine. When some three hundred cases of encephalitis occurred in one year in Missouri, excitement ran high in lay and medical circles. In the same year, there were the same number of cases of malaria in Tennessee, a non-malarial state, but no attention was paid to this situation. He advocated a curb on the sale of "chill tonics" as part of a seven-point program for checking the ravages of malaria. In his opinion these "tonics" are "pernicious" and actually contribute both to deaths from malaria and to the development of many cases of chronic malaria. Dr. E. L. Bishop, director of health for TVA, reported that guarding against the malaria threat has been an important feature of the TVA construction and development program. Control of malaria depends to a large extent on eliminating stagnant water where the malaria mosquito might breed. The extensive shorelines of the huge lakes behind the Norris and Wilson dams might have provided breeding grounds for myriads of dangerous mosquitoes and made malaria control throughout the area practically impossible. Each dam constructed by the TVA was designed in cooperation with health authorities, so that clean shorelines and other conditions unfavorable to the breeding of mosquitoes were provided. In addition, no reservoirs are filled during the mosquito breeding season.

BALTIMORE MEETING OF THE SOUTHERN MEDICAL ASSOCIATION

NEW, better methods of diagnosing and treating thyroid gland disease, especially toxic goiter of Graves's disease, were described by Dr. David Henry Poer, of Emory University, Atlanta, Ga., at the meeting of the Southern Medical Association. The old method of determining whether a patient suffered from overactivity or underactivity of the thyroid gland was to fit a mask over his face through which a measured amount of oxygen was supplied. From the time needed to use up the oxygen, the physician could determine the patient's oxygen consumption and from that his basal metabolic rate, or the speed at which his thyroid gland was driving his body in its various activities. This test has turned out to be rather unsatisfactory. A new test, pleasanter for the patient, though it takes longer, is now available. This

test is made by taking a sample of the patient's blood and determining the amount of iodine in it. As iodine is part of the chemical which the thyroid gland makes and by which it influences body activity, this test for the amount of iodine in the blood tells the physician whether the gland is making too much or too little of the active chemical.

Dr. Huntington Williams, health commissioner of Baltimore and professor of hygiene and public health at the University of Maryland, spoke on the death rate from measles. Figures covering a ten-year period in Baltimore show that the risk of death from measles for a child under one year of age is forty-seven times greater than for a child between five and fourteen years of age. Deaths from measles are due to ignorance and neglect. Every effort should be made to keep children under three years away from measles. This is only difficult during an epidemic of the disease, and in cities and urban communities, measles epidemics come quite regularly every two or three years.

—JANE STAFFORD

TESTING OF PRISON BARS

THE newest aid of science in combating crime is the magnetic apparatus developed at the National Bureau of Standards to test the properties of tool-resisting prison bars. The device was developed by R. L. Sanford, senior physicist at the bureau, at the request of the Bureau of Prisons and the Department of Justice.

At the meeting of the Philosophical Society of Washington on November 7, Mr. Sanford showed how a non-destructive test on prison bars had been achieved with his alternating current magnetic comparator. Usefulness of the device will be to test new bars purchased by the Federal Government for prisons.

Prison bars are really two bars blended into a solid whole. Outside is softer ordinary steel which can be cut with a hacksaw. But within are inserts of hardened steel that can not be cut by any tool which a prisoner is likely to obtain. This dual type of construction of bars is necessary because the inner, very hard steel is brittle and if used alone might be shattered by a sharp blow in quite the same way that one may break the blade of a knife if it is used as a screwdriver. In the prison bars the outer, softer material absorbs the shock of a blow and protects the inner, hard material from fracture. Moreover, the outer steel is an excellent heat conductor and prevents the prisoner from heating the inner steel if he employs a home-made blowtorch consisting of a candle and a soda straw.

The prison bars are tested in a balanced electrical circuit which can be thought of roughly as an electrical scale in which the magnetic properties of a standard and test sample of steel are compared. The primary premise behind the device is that two steel bars which are alike chemically and structurally will be alike, also, in magnetic properties. And that it is impossible to do anything to a piece of steel which will change its strength without, at the same time, altering its magnetic properties. Thus, if one finds that the magnetic properties of the sample correspond to those of a known, approved standard the two are otherwise alike.

ITEMS

FOUR months of field tests in television broadcasting from the Empire State Building, New York City, at the cost of a million dollars have brought television for the public nearer to reality. The engineers of the Radio Corporation of America and the National Broadcasting Company report that they have not yet finally designed the television sets that will be sold for the general public. Television as demonstrated was seen on a new 12-inch receiving tube. And the images were in black and white, instead of the greenish tone of previous cathode ray tubes. The screen was 7½ by 10 inches and a fairly large group could watch the show at the same time. Image and sound were perfectly synchronized. To do this a system is necessary in which there are 1,400,000 impulses amplified and broadcast in one second.

THE average motor car now in use is nearly five years old (4.71 years) according to an analysis of passenger-car registration presented to members of the American Petroleum Institute meeting in Chicago on November 12. Such cars are well past "middle age" in the survival life on an automobile, which is 8.4 years, according to a report made by Marcus Ainsworth, of Automotive Industries, and A. Ludlow Clayden, of the Sun Oil Company. The automotive engineers were able to arrive at their findings by making a mortality curve for automobiles. The cars in "per cent. living at the end of each year" were plotted vertically and the years from 1935 back to 1922 forming the base line. Sixty per cent. of all the cars in use at the end of 1935 consisted of the three most popular low-priced makes—10,845,295 out of 17,896,616 cars.

OLD age can be held at bay and life itself prolonged some seven years by dietary means according to evidence obtained in nutrition studies with rats made by Dr. Henry C. Sherman, Mitchill professor of chemistry at Columbia University and research professor of the Carnegie Institution of Washington. The diet which extended the prime of life in rats had an increased proportion of milk, making the diet richer in vitamins A and G, calcium and protein, Dr. Sherman reported in a lecture given before the institution. This diet "expedited growth and development, resulted in a higher level of adult vitality as shown by several criteria, and extended the average length of adult life, or improved the life expectation of the adult." Extension of life expectation has heretofore been made for lower age levels by hygienic means which reduced the chances of death by diseases of infancy and childhood. By applying the new knowledge of nutrition, Dr. Sherman believes it is now possible to extend life during "the period of the prime." Because eminent men usually attain their positions of "fullest opportunity" at an age when only the last third of their years remain to render "fullest service to the world," Dr. Sherman believes that the possibility of extending the prime period of life has greater than biological significance.

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SCIENCE NEWS

Science Service, Washington, D. C.

PATENT FOR AUTOMATIC "ELECTRIC EYE" CAMERA GRANTED TO DR. ALBERT EINSTEIN

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DR. ALBERT EINSTEIN, proponent of relativity and acknowledged leader of the science of mathematical physics, stands revealed on the records of the U. S. Patent Office in Washington as the inventor of a camera which snaps photographs with the proper aperture and exposure automatically determined. He has applied the photoelectric cell or "electric eye" to cameras. Experts reading the patent specifications foresee the possibility that the invention will be practically and commercially important in the next few years. The patent is No. 2,058,562 and the application was filed on December 11, 1935, by Dr. Einstein jointly with Dr. Gustav Bucky, of New York City.

This is the way the Bucky-Einstein camera works: Light from the scene or object being photographed comes into an auxiliary lens and falls on the photoelectric cell. There is a screen of varying transparency mounted in the main camera lens system that is moved in accord with the amount of light that the electric eye sees, letting more light fall on the photographic plate when necessary. So far as can be judged, abstruse mathematical theory was not needed in designing the patented camera but Einstein's genius probably contributed largely to making it operate correctly. What plans Dr. Bucky and Dr. Einstein have for commercializing the invention are not yet known. The device can be adapted to motion picture cameras.

Dr. Einstein is the leading member of the Institute for Advanced Study at Princeton, N. J., which works in co-operation with Princeton University, but is not a part of it.

Dr. Bucky is a radiologist practicing in New York City, with offices at 5 East 76th Street, and is also connected with New York University. Dr. Bucky is a naturalized American citizen of German birth. He practiced in Berlin until 1923 when he came to America. He is the inventor of a diaphragm in general use in x-ray photography.

A search of the U. S. Patent Office files showed that Dr. Einstein is also a co-inventor of two other patents. These relate to refrigeration and were taken out jointly with Leo Szilard, who is believed to be the well-known radiologist at St. Bartholomew's Hospital, London. These two patents, British No. 282,428, granted November 15, 1928, and U. S. No. 1,781,541, granted November 11, 1930, cover a new system of circulation in the gas-type of refrigeration and the use of butane gas as the refrigerant. The U. S. patent is assigned to the Electrolux-Servel Corporation of New York and is believed to have been commercially profitable.

GIFT TO THE GOVERNMENT OF A PATENT ON A NEW, SAFER MORPHINE

ONE week after the destruction by the Bureau of Engraving of $15,000,000 worth of the narcotic drug, heroin, the Secretary of the Treasury accepted the patent rights to another narcotic drug. This is the new, safer morphine prepared by Dr. Lyndon F. Small, of the University of Virginia. Dr. Small formally presented his patent rights to Secretary Morgenthau on December 1. Both these seemingly contradictory actions are being taken as part of the government's fight to control the evil of narcotic drug addiction.

The destruction of the heroin was in conformity with regulations of the International Narcotics Convention. Heroin, a morphine compound, is considered the most vicious of habit-forming drugs. The new morphine prepared by Dr. Small will, it is hoped, prove to be without addiction, or habit-forming, properties. The goal of a non-habit-forming morphine is being sought in a fundamental attack on narcotic drug addiction launched in 1929 by the National Research Council, the U. S. Public Health Service and the U. S. Bureau of Narcotics. The research on morphine substitutes is being carried on at the Universities of Virginia and Michigan.

A morphine compound which it was hoped would be without addiction properties was prepared and patented by Dr. Small two years ago. The patent rights on this were also turned over to the Secretary of the Treasury by Dr. Small. When clinical trials showed that the compound was more habit-forming than ordinary morphine, the Surgeon-General of the U. S. Public Health Service recommended to the Secretary of the Treasury that the United States Government prohibit the importation, manufacture, sale or distribution of this drug in the United States. The latest morphine prepared and patented by Dr. Small is less poisonous, more powerful in relieving pain and acts longer than ordinary morphine. Whether it will be equally, more, or less habit-forming than ordinary morphine can not yet be told. Clinical trials to determine this point are now under way, but have not been concluded.

INVENTION, THE PATENT SYSTEM AND INDUSTRIAL PROGRESS

SCIENTIFIC and inventive ability, and a patent system which fosters and protects them, have made the United States world leader in material progress, according to Dean Dexter S. Kimball, of the College of Engineering of Cornell University, in a speech made in Washington, on November 23, in connection with the Centennial Celebration of the American Patent System.

"The census of 1850 records the national wealth as $7,135,780,228 and the *per capita* wealth as $308. The census of 1930 lists the national wealth as $329,700,000,000 and the *per capita* wealth as $2,677. The United States, with about seven per cent. of the world's population, owns half the world's communication facilities, nearly half the world's railways, has one automobile for every five persons, whereas the four other leading nations have one for every 59 persons; has one telephone to every seven persons as compared with one for each 35 in the other leading four nations, and one radio for every six

persons as against one for every 17 in the same lands. How could all this have been accomplished except through the application of these great inventions to our unparalleled national resources?''

During depressions, caused by upsets of the delicate balance of the modern business system, a cry goes up against technological unemployment. This cry ignores the fact that the present economic levels could only have been reached by the use of machines. Moreover, the cry against machines in the last depression occurred when, even at its lowest, the economic status of the people was still immensely better than the best living of the average workers before the industrial revolution—introduced by machines—started near the end of the eighteenth century.

DISCOVERY OF TITANIUM IN INTERSTELLAR SPACE

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DISCOVERY in far-off interstellar space of what is probably ionized gas of the element titanium, which astronomers say is likely to prove of great significance in learning the content and nature of these nearly vacuous regions, has been reported to the Harvard Observatory by the Mount Wilson Observatory in California. The discovery was made by Dr. Walter S. Adams, director of the Mount Wilson Observatory, and Dr. Theodore Dunham, a member of the staff, while they were conducting research on the ultra-violet part of the spectrum of the bright star Chi 2 Orionis.

Harvard astronomers said: ''It seems probable that if the discovery of the interstellar titanium is confirmed it will give information concerning the content and nature of interstellar space that is of more importance than was the discovery of the sodium and calcium of nearly empty space.'' Dr. Adams and Dr. Dunham reported that the star Chi Aurigae also shows the new titanium lines and it is probable that further research on the spectra of the hot stars will reveal the presence of this intervening matter in all directions from the earth. In their announcement they give with high precision the wave-lengths of the new interstellar lines and point out that their intensities as well as their wave-lengths are essentially identical with those of the titanium lines known from laboratory researches. They will now attempt to find a confirming titanium line at a still shorter wave-length.

In addition to the three sharp lines in the extreme ultra-violet that are almost certainly ascribable to ionized titanium gas, the two astronomers found two other ultra-violet spectral lines which they attribute to interstellar sodium. The presence of sodium and calcium in these spaces between stars has been known for many years, however. There still remain other interstellar lines found some years ago by Dr. Paul Merrill, of the Mount Wilson Observatory, which have not yet been identified. The spectra were made with a special ultra-violet spectrograph in connection with the hundred-inch telescope. This instrument makes use of a quartz prism, a special Schmidt camera, and a large plane grating of remarkable qualities recently made by Professor R. W. Wood, of the Johns Hopkins University.

WESLEY FULLER

GLUTATHIONE OF THE THYMUS IN NORMAL AND CANCEROUS GROWTH

(Copyright, 1936, by Science Service)

CASUALLY pulling rats out of his pockets like a magician instead of a scientist, Arthur Steinberg, of the Philadelphia Institute for Medical Research, just as casually made the first announcement of what may prove the major medical discovery of the decade in his demonstration in the Research Parade arranged by Science Service as part of the centennial celebration of the American Patent System.

Mr. Steinberg told his audience, after first amazing them with a demonstration of the precocious growth and development attained by rats treated with thymus gland extract, that glutathione, the chemical believed responsible for normal growth and for cancerous growth, is found in the thymus gland. The extract was prepared by Dr. A. M. Hanson, physician of Faribault, Minn. Its rôle in stimulating growth and development was demonstrated at the Philadelphia Institute for Medical Research under the direction of Dr. L. G. Rowntree. Discovery of the relation between the thymus gland and glutathione, seems to promise important new leads for solving problems of abnormal growth, even possibly including such abnormal growth as cancer.

Thymus glands from calves are known as sweetbreads. Aside from their use as a table delicacy, they had never attained importance until Dr. Hanson made his now famous extract and showed the gland's importance as a growth-promoting organ. Feeding this extract to white rats makes the next generation of rats develop much earlier and grow much larger than their parents. As each successive generation is fed the extract, growth and development is speeded up in the offspring at a truly amazing rate. In the tenth generation the rats matured in about one fifth the time it takes for a normal rat to mature.

The thymus gland plays its rôle of controlling growth and development in the young, it now appears, by means of the powerful chemical glutathione. This chemical can speed up cell division and thus influence both normal growth and the abnormal growth that is cancer. When chemical analysis of thymus gland extract showed that it contained glutathione, Dr. Rowntree and his associates started feeding the pure chemical to white rats, as they had fed the animals thymus extract. The results were the same as with the gland extract, only even more striking. Successive generations of rats whose parents were fed glutathione grew and developed at an even faster pace than the animals that had been fed the thymus gland extract.

Whether the gland manufactures this chemical, as the pancreas does insulin, or whether it merely is a storehouse for the chemical, Mr. Steinberg did not state. That and possible practical applications of the latest discovery must await further research.

STERILIZATION LAWS

AMERICA has set an example to the world in her enactments of laws providing for eugenic sterilization, Dr.

Marie E. Kopp told physicians attending the symposium on sterilization held by the New York Academy of Medicine. The first statute in the world providing for sterilization of the unfit was enacted in Indiana in 1907, while the first European sterilization law was passed in 1928 in the Swiss Canton de Vaud. Since then similar laws have been passed in Denmark, Germany, Sweden, Norway and Finland.

Dr. Kopp, who was sent abroad by the Oberländer Foundation to study the European laws first-hand, said that in the Swiss Canton de Vaud in six years since enactment of legislation providing for eugenic sterility only 46 sterilization operations had been performed, while in Germany since January 1, 1934, when German law went into effect, 205 hereditary health courts have adjudicated more than two hundred thousand petitions for sterilization.

The great difference in these figures reflects some of the differences among the various laws as regards the scope of their compulsory features. Except in Germany, the European laws apply to persons who are technically "public charges." German legislation extends, however, to persons afflicted with certain hereditary diseases. "The European laws enacted to date emphasize the voluntary spirit with which it is desirable to have the petitioner make his application." Compulsory sterilization of public charges is, however, provided for in the laws.

Responsibility for deciding that a sterilization operation is necessary does not lie with the individual physician. Under the eugenic laws in Europe investigation is in charge of the Department of Public Health and decision in individual cases is made in the name of the commonwealth. Operations must be performed in approved hospitals by qualified specialists. The cost is borne by the institution normally charged with care of the defective individual.

ITEMS

DROUGHT threatens to be an unwelcome visitor again in the Midwest and Northwest. Last week's crop-weather survey of the U. S. Weather Bureau shows severe lack of moisture in a wide sector from the upper Mississippi Valley to the Canadian border and the Pacific coast. Dust storms have raged in regions as widely separated as Iowa and Washington, severe wind erosion has occurred in Wyoming, and in Missouri, three consecutive weeks have passed without appreciable rain or snowfall.

IF the Siamese twin, Simplicio Godino, survives the operation which separated his body from that of his twin brother who died of pneumonia, he will be the fifth person in all medical history known to have survived such an operation. He may, in consequence, be more interesting as an unusual human type than he was as one half of a pair of Siamese twins. Dr. Alan F. Guttmacher, of the Johns Hopkins University, Baltimore, reported in a recent discussion of the subject that only four successful operations to separate Siamese twins have been reported in the history of medicine. All these operations were performed on children, the eldest being only twelve years old at the time of operation. The age of the Godino twins is given as 28 years. In the case of the 12-year-old twins, the "Radica-Doodica" Hindu sisters, the operation was performed in Paris in 1902 by the French surgeon, Doyen, in order to save Radica's life. Both these twins were gravely ill from tuberculosis. Doodica was almost dead before the operation and died shortly after. Radica survived and regained complete health. The two original Siamese twins, Chang and Eng, died within a few hours of each other. Chang had been sick and died first. The shock of awaking to find his brother dead is said to have killed Eng. Dr. Guttmacher commented on this that if a surgeon had been immediately available, an emergency operation would probably have saved Eng's life.

MODERNISTIC buildings of thirteenth century America, that looked as new to gaping Indian crowds as streamlined buildings look to us to-day, were described recently by H. E. D. Pollock, archeologist of the Carnegie Institution of Washington. Round buildings were new-fangled notions to Indians of Yucatan almost seven hundred years ago. Mr. Pollock, lecturing on Mayan Indian architecture, told of the unique circular tower at Chichen Itza, a great city-state of the Mayan Indians in Yucatan, which archeologists have partly restored. Round buildings of any sort continued to be rare among stately edifices of Mayan cities. Another new and exotic idea in thirteenth century America was to replace interior walls with rows of columns. This produced temples with great colonnades roofed by vaults or relatively light, flat ceilings. Indian invaders from Mexico influenced the Mayas in their architectural new era.

WHAT is believed to be the oldest musical instrument known to man has been discovered at ancient Tepe Gawra, Mesopotamia, according to Professor Millar Burrows, Yale Divinity School, president of the American Schools of Oriental Research. The instrument, part of a double pipe of bone, dates from the Chalcolithic Age, when man was shifting from the Stone Age to the Age of Bronze. Tepe Gawra, famed as the world's oldest known city, is being excavated by a joint expedition of the University of Pennsylvania Museum and the American Schools of Oriental Research, under direction of Professor E. A. Speiser, of the University of Pennsylvania. Another discovery from the Chalcolithic Age, of great importance to art history, is a large bowl decorated with red paint in panels showing sections of landscape, including mountains, rivers, animals and even a hunting scene. From a higher level of the mound at Tepe Gawra, about 3000 B.C., comes a carnelian bead of a kind characteristic of the ancient Indus Valley culture, one of the many illustrations of the commercial contacts between India and Mesopotamia in the early dynamic period. To determine the date of a remarkable round house discovered toward the end of the last season's campaign, the expedition is carrying the whole excavation down to a level previously reached in a small segment of the mound. When this has been done the lower levels will be investigated in order to establish the sequence of the ruins and of the prehistoric painted pottery.

Four New McGraw-Hill Books

Loomis and Shull—Methods in Plant Physiology

By W. E. LOOMIS, Iowa State College, and C. A. SHULL, University of Chicago. With a chapter on Statistical Methods by G. W. SNEDECOR, Iowa State College. *McGraw-Hill Publications in the Agricultural and Botanical Sciences.* 464 pages, $4.50

This book is written for the plant scientist with only moderate training in chemistry and physics, and attempts to outline and explain the methods used in plant physiological research, as well as to give tested laboratory experiments with questions, for class use. The laboratory section is unusually complete, comprising thirteen chapters of experiments covering the field of plant physiology and ranging in complexity from simple demonstrations to research techniques. There are nine chapters covering chemical and physical methods for plant physiology.

Rieman and Neuss—Quantitative Analysis.
A Theoretical Approach

By WILLIAM RIEMAN, Rutgers University, and JACOB D. NEUSS. *International Chemical Series.* 416 pages, $3.25

The approach is new in that more than usual emphasis is placed upon the theoretical aspects of the subject and the intimate relationship between the theory and laboratory procedures. Another distinctive feature is the early introduction of potentiometric measurements, facilitating the discussions of acidimetry, alkalimetry, oxidimetry, electroanalysis, and measurement of pH. There is an exceptionally full discussion of coprecipitation. Two hundred fifty-eight problems and questions are included.

Hutcheson, Wolfe and Kipps—The Production of Field Crops
A Textbook of Agronomy. *New Second Edition*

By T. B. HUTCHESON, Virginia Polytechnic Institute, T. K. WOLFE, Southern States Cooperative, and M. S. KIPPS, Virginia Polytechnic Institute. *McGraw-Hill Publications in the Agricultural and Botanical Sciences.* 434 pages, $3.50

In revising this well-known textbook the authors have kept in mind a two-fold objective: first, to incorporate the many advances in agronomy made since the publication of the first edition of the book; and second, to adapt the material more closely to the requirements of the usual course. As before, the first part of the book is devoted to a discussion of the fundamentals underlying the production of crops in general, followed by detailed treatments of individual crops. A list of questions has been placed at the end of each chapter.

Emmons—Gold Deposits of the World

By W. H. EMMONS, University of Minnesota. *In press—ready in February*

A thoroughly up-to-date, comprehensive textbook giving brief descriptions of all of the world's chief gold mining regions and most of the lesser ones. Besides presenting much new material which has not heretofore been published, the book offers about 500 maps and geological cross sections. These show in general the intrusives with which the lodes are associated, the rocks older than the intrusives, and the rocks younger than the intrusives. The principal gold deposits are located on these maps. A section on prospecting is included.

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SCIENCE NEWS

Science Service, Washington, D. C.

THE SIMULTANEOUS CALCULATOR

A ONE-TON machine that in a single action can solve nine simultaneous equations with nine unknowns so complicated in form they might well require days of laborious computation by trained mathematicians has been developed at the Massachusetts Institute of Technology. Known as the simultaneous calculator, the machine is the product of three years' research by Dr. John B. Wilbur, of the department of civil engineering. Cooperating with him has been Dr. Vannevar Bush, vice-president and dean of engineering, who, under the program of the institute to eliminate delay and complications in engineering and research, has previously made important contributions to the mechanical solution of mathematical problems, including the differential analyzer.

The simultaneous linear algebraic equations solved by the new machine occur constantly over a wide range of engineering and scientific analyses. Thus although it was originally designed for the solution of problems in civil engineering, such as those involved in the construction of skyscrapers, it is expected to prove equally useful in such diverse fields as nuclear physics, geodetic surveying, genetics and psychology. The mathematician will be able to use it for the evaluation of determinants especially and in several other fields, since the machine under some circumstances can solve for even more than nine unknowns.

The machine weighs approximately 2,000 pounds and has more than 13,000 separate parts, including 600 feet of flexible steel tape and almost 1,000 ball-bearing pulleys. The outgrowth of an experimental model built by Dr. Wilbur two years ago, the new machine has undergone exhaustive tests and is now in active operation.

The simultaneous equations which constitute the basis of the machine's operation are mathematical expressions relating a number of unknown quantities in such a way that the value of each unknown may be determined by a simultaneous consideration of the relations involved as expressed by the equations. In the design of a suspension bridge, for example, the stresses on each part depend on the stresses on other parts. In addition, each of these stresses depends on the physical elastic properties of the parts themselves. Yet the value of the stresses can be calculated by solving a set of simultaneous equations which show the relations between these various stresses. In the usual analytical solution this process involves considerable laborious manipulation of the factors. With Dr. Wilbur's new machine, however, it is necessary only to set a series of tilting plates to account for the various coefficients and constants and a single movement of the mechanism performs in a few seconds computations that might take days by ordinary methods.

Construction was made possible by a fund established by Sir Douglas Alexander, of New York City.

THE SHORTEST CONTINUOUS RADIO WAVES

THE shortest continuous radio waves ever produced are being used in experiments at the University of Michigan. According to the report of Drs. C. E. Cleeton and N. H. Williams, of the department of physics, they are only 6.4 millimeters (about one quarter inch) in wavelength. So tiny is the tube used to generate the waves that it is assembled under a magnifying glass and its outside dimension is less than one quarter of an inch. Radio radiation generated by the equipment is being used for studies of the molecular structure of gases including water vapor. The minute rays have many of the properties of light and travel in straight lines when focussed by a concave mirror. Pieces of black paper, hard rubber and wood are transparent to the rays.

The possibility of using them for communication purposes is remote, since they are rapidly absorbed by the water vapor in the atmosphere. It is by a study of this absorption that new facts may be learned about the molecular makeup of water vapor. The 6.4-millimeters radio waves represent about the limit of radiation which can be produced from vacuum tube sources. To get shorter waves the dimensions of the radio tube must be decreased and this ultimately becomes a mechanical impossibility. For waves shorter than six millimeters it is necessary to use either the radiation from a quartz mercury arc lamp or spark sources in air. The wavelength region from one tenth millimeter to six millimeters waves is about the last untapped "no man's land" of infra-red research, for only a few isolated measurements have as yet been made in this region.

NEW APPARATUS FOR OBTAINING SAMPLES OF DEEP OCEAN BOTTOM

SAMPLES of ocean bottom gouged out of ten feet of solid mud or silt by a new type of apparatus have been undergoing analysis at the Carnegie Institution of Washington. They are expected to tell new stories of the geological and biological history of the depths, hitherto hidden because no previously existing form of apparatus could do more than scoop up a superficial handful of material from the ocean floor.

The device, called a core sampler, has been developed in the laboratories of the Carnegie Institution by Dr. Charles A. Piggot, of the Geophysical Laboratory. It consists of a short, thick-walled cylinder with a plunger that can be driven forward by a charge of cannon powder. Attached is a ten-foot tube of tempered steel, which is called the bit. When this sampler comes into contact with the bottom, the powder is exploded and the bit is driven into the ocean floor, gouging out a sample as a watermelon plugger takes a sample of the fruit into which it is plunged. The bit is lined with a thin brass tube, which is removable. The ocean bottom sample remains in this, to be corked up and filed away for study in the laboratories on shore. A new lining is shoved into the bit, the powder chamber in the gun reloaded, and the sampler is ready for use.

The first real deep-water samples were taken during the oceanographic season just closed, through the cooperation of one of the great commercial cable companies, which had to send out a powerful repair ship, the *Lord*

Kelvin, to mend a break in a trans-Atlantic cable. Because of the ample deep-water gear carried by this vessel, and its ability to "maintain station" at sea in any weather, and particularly because of the skill of its specially trained Nova Scotian crew, it was possible to obtain eleven samples of Atlantic Ocean bottom at depths ranging up to 2,640 fathoms, or three miles.

CANCER GROWTH CHEMISTRY

CANCER tissue, contrary to generally held opinion, requires the same sort of protein nourishment for its growth as normal tissue does. Experiments showing this are reported by Drs. Carl Voegtlin, J. M. Johnson and J. W. Thompson, of the U. S. Public Health Service's National Institute of Health, in the current issue of *Public Health Reports*. The results of the studies, in which the growth of cancers in mice were checked by certain types of diet, can not be applied in the treatment of cancer in man. New fundamental knowledge of the chemistry of cancer growth, however, has been gained. The growth of breast cancer in mice can be checked by feeding the animals a diet deficient, though not entirely lacking, in cystine. This chemical is an amino acid, one of the essential building stones of all tissue proteins. Cystine is also part of another chemical, glutathione, which is widely distributed in body tissue and which apparently stimulates the multiplication of normal body cells. After the cancer growth in the mice had been checked for about a month by the diet deficient in cystine, repeated injection of glutathione caused a marked stimulation of the cancer growth. This shows that glutathione is necessary for the rapid growth of cancer tissue just as it is apparently necessary for growth of normal tissue. Previous studies by Dr. Voegtlin and associates showed that deficiency of another of the body's protein building stones, lysine, also checked the growth of cancer in mice.

STERILIZATION OPERATIONS PERFORMED IN THE UNITED STATES

TWENTY-EIGHT states have laws providing for the compulsory or voluntary sterilization of mentally deficient persons, and under these laws at least 23,118 operations have been performed, William J. McWilliams, Counsel for the National Committee on Maternal Health, reported at the Symposium on Sterilization held by the New York Academy of Medicine. He warned his audience, however, that before performing a sterilization operation they should remember Judge Cardozo's statement, applying to all surgery, that "a surgeon who performs an operation without his patient's consent commits an assault for which he is liable in damages—except in cases of emergency where the patient was unconscious." The consent to the sterilization may be given by the patient, or by the patient together with his parents or guardian, or it may be imposed by state officials, Mr. McWilliams said. When a sterilization operation is performed as an incident to curing a disease, this is lawful, if the patient has consented.

X-rays or radium are the best methods for sterilization of women. Sterilization by irradiation presents few difficulties and there is little likelihood of any adverse reactions following treatment. A further advantage lies in the fact that the patient need not enter a hospital to be treated. In order to obtain effective results irradiation sterilization must be carried out only by those properly prepared by training and experience in the employment of x-ray and radium treatment. Otherwise harm might result from overdosage.

Dr. Eliot Bishop, discussing surgical methods in use for sterilization of women, said that he had had good results at the Brooklyn Hospital and the Methodist Hospital by using the procedure devised by Pomeroy. According to this method, a loop of the fallopian tube—through which the ovum descends from the ovary—is caught up and ligated with an absorbable suture. The loop is then cut off. According to Dr. Bishop this operation has the merit of being simple and entirely safe.

FORMATION OF SEEDLESS FRUITS IN UNPOLLINATED FLOWERS

SEEDLESS tomatoes and peppers have been induced to form in unpollinated flowers by treating the fruit-producing parts, or ovaries, with any one of four different organic acids, Dr. Felix G. Gustafson, of the University of Michigan has reported to the National Academy of Sciences through that body's official proceedings. Similar results were also obtained with the fruits and seed-pods of a number of other vegetables and garden flowers. While no immediate commercial application is contemplated, it is interesting to note that in the tomatoes at least the seedless specimens had very small seed-spaces—indeed in some of the smaller ones the flesh was completely solid. Immediate commercial exploitation is regarded as impracticable at present because each flower requires individual operation by a skilled botanist. The real significance of the experiments is the proof that fruit production without pollination is possible through the use of growth-promoting substances.

The chemicals used by Dr. Gustafson were indole-propionic acid, indole-butyric acid, indole-acetic acid and phenylacetic acid. All of these have been used by a number of botanical researchers to promote the growth of stems and leaves on dormant plants and parts of plants. One, indole-acetic acid, has been found in extracts of plants and has been called heteroauxin because it acts in promoting growth like auxin, the natural growth-promoting substance. The four acids were mixed into a kind of salve with hydrous lanolin for application to the places where growth promotion was desired. In this, Dr. Gustafson followed the technique developed at the Boyce Thompson Institute for Plant Research at Yonkers, N. Y., by Drs. P. W. Zimmerman and A. E. Hitchcock, which won for its originators the $1,000 annual prize of the American Association for the Advancement of Science a year ago.

In the experiments, the stigma or natural pollen-receiving surface was cut off and the growth-promoting acid preparation smeared on the cut surface. From there it diffused into the unpollinated ovary and caused the development of all parts except the fertile seeds themselves. In some of the species used, seeds did develop, but when

they were cut open they were found to be hollow, without the tiny embryo plant necessary for germination. In other cases, as in the seedless tomatoes, the fruits grew and ripened normally and did not contain even hollow seeds. In still other cases, there was relatively little fruit development.

In all the experiments, parallel controls were carried through. This was done in two ways: by pollinating companion flowers to the ones under treatment, and by keeping others both untreated and unpollinated. The pollinated flowers developed fruits or pods with seeds, as was expected, while the unpollinated ones simply died and dropped off.

Dr. Gustafson sums up the results of his numerous experiments in two sentences: "The significance of these experiments seems to be that definite substances, which are not specific, cause the ovary of a flower to develop into the fruit. These substances seem to be closely related to the auxins."

RADIO THERAPY

DOCTORS whose business is saving lives may be unwittingly endangering other lives through the use of therapeutic equipment that interferes with radio communication. Radio messages between ships and shore, aircraft and ground and directional signals upon which human lives depend can be seriously interfered with by "sky waves" of considerable intensity set up by the short wave diathermy and artificial fever devices now employed by many physicians. Dr. H. B. Williams, of New York City, warns physicians of the nation through the *Journal* of the American Medical Association that they must take prompt steps to abate this nuisance. Otherwise, he states, that relief through legislation will be sought, with a possibility of undesirable restrictions being placed on the use of therapeutic machines. The council on physical therapy of the American Medical Association is expected shortly to alter its requirements for acceptance of electrical equipment such as is known to have caused interference. Manufacturers will be asked to submit evidence that the construction and installation specifications are such as to prevent interference. Even when not a menace, the physician's and surgeon's diathermy machine may be a nuisance, causing static in every radio receiving set that derives power from the same line, Dr. Williams points out. The chief instance of radio interference from this cause came last winter when important activities of the Naval Research Laboratory at Washington, D. C., were subjected to interference so serious as to stop the work completely. After great trouble and expense, the disturbance was eventually traced to a diathermy unit located in a hospital at Cambridge, Mass.

ITEMS

So acute is Germany's need for grease and fats that large scale recovery of drain-pipe greases is to be undertaken, according to reports received at the Bureau of Foreign and Domestic Commerce, in Washington, from the American Consulate at Frankfort-on-Main. It is estimated that from 25,000 to 30,000 tons could be obtained annually from this source. Salvaging drain-pipe fats and grease is another side to the general problem of obtaining more fats for the German nationalism program which led, recently, to the plea by the Commissar for Food Control that Germans eat less fat in the future.

THE threat of death is now lifted from the heads of royalty and commoners alike who suffer the dangerous, hereditary disease of hemophilia. These men and boys (the disease is transmitted by women but afflicts only males) need no longer lead a timid, hot-house existence for fear a scratch or slight exertion will bring on fatal bleeding. The remedy, which could have saved the lives of kings and princes of the past, has been discovered by Drs. W. A. Timperley, A. E. Naish and G. A. Clark, of the University of Sheffield. Egg white thoroughly mixed with potassium bromide and kept in an incubator at body temperature for several days yields a substance which makes blood clot quickly and firmly, they report to *The Lancet*. Failure of the blood to clot at the normal rate of speed is the dangerous characteristic of hemophilia. The new remedy can not be called a cure but the report shows it to be a promising treatment.

RISING over 30,000 feet higher into the air than the regular weather observing airplane, a robot weather balloon has ascended high above the earth in the first nighttime radio meteorograph balloon ascension in this country. This pioneering flight was conducted at five A. M. (November 30) immediately following the regular weather flight by airplane. Dr. Charles F. Brooks, director of the Blue Hill Observatory of Harvard University, found the minimum temperature of 77 degrees below zero Fahrenheit when the balloon reached a peak altitude of 50,000 feet, one hour and 12 minutes after its release from the earth. While the radio speaking weather balloon shot up through the lower part of the atmosphere it showed the same form of temperature curve as that brought back by the weather observing airplane. There was a 13-degree fall to 3,500 feet, then a sharp 2-degree rise, followed by 23-degree fall to 17,000 feet. The instrument was designed by Dr. K. O. Lange and A. E. Bent, research associates at Harvard, and built by R. D. Feiber. Dr. Lange and Mr. Feiber released the three balloons and instrument, and C. B. Pear, Jr., received the radio signals, which were recorded by two chronographs designed for the purpose. The results, including a humidity record, will be reported to the International Commission for the Investigation of the Free Atmosphere, which designated November as a month for special effort.

THE first airplane to complete a trans-continental flight across America—it took 84 days—has now been placed beside Colonel Lindbergh's *Spirit of St. Louis*. The plane suffered fifteen crackups *en route* in 1911 and arrived in California with only its original rudder and two wing struts. A freight train followed along with spare parts. Galbraith Perry Rodgers, who flew it, spent a month in a Pasadena hospital. The present flying time for the same trip is now nine hours and twenty-six minutes.

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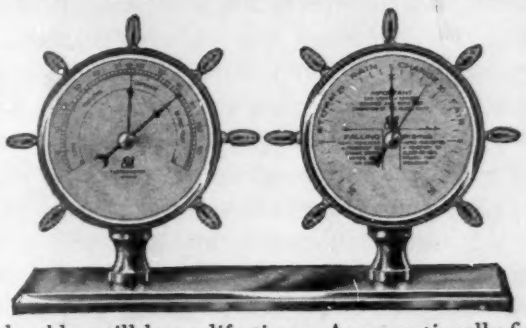

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SCIENCE NEWS

Science Service, Washington, D. C.

SEVEN MINUTE SOLAR ECLIPSE OF 1937

THE longest total eclipse of the sun since 1804, lasting seven minutes and four seconds, is the chief event on the astronomer's calendar for the new year. This will happen on June 8. Unfortunately, there is no land at the place where it lasts longest, in the middle of the Pacific Ocean. Useful observations can be made from shipboard, but the slight unsteadiness of a ship, even on a calm sea, will prevent many researches for which this long eclipse would be ideally adapted.

On June 8 the shadow first touches earth in the Pacific Ocean in the vicinity of the New Hebrides, where the sun will rise eclipsed. Then it crosses the ocean and leaves the earth in Peru, where the sun sets while still hidden. At both the beginning and end of the track, the duration will not be as much as at the center, and the sun will be very low in the sky, which will hamper observations. At the center of the path, latitude 9 degrees 54 minutes north and longitude 130 degrees 40 minutes west, the eclipse occurs at noon, the sun will be nearly overhead and will be hidden for the full time. But the only islands which the shadow track touches are Christmas Island and Fanning Island, one on the northern, the other on the southern edge, where the duration is not much more than two minutes.

One of the greatest values of such a long eclipse would be long exposure photographs, possibly with infra-red sensitive plates, to record the outermost and faintest parts of the sun's corona, its outer layer which appears only at eclipse time. Because of the instability of a boat, only short exposures will be possible. However, good eclipse pictures have been made from airplanes and a boat should be much better. Also, there are other eclipse observations, such as those of the behavior of radio waves in the moon's shadow, that can be made just as well from shipboard as from land. In addition to the scientific aspects, a total eclipse of the sun is perhaps the most impressive spectacle that nature has to offer and this one should be the finest in many years. Probably cruises will be operated to take spectators to watch it, and these naked-eye observations will be just as satisfactory from a ship as from any other post. At this time of year the weather should be perfect and the seas very smooth.

A third eclipse will happen during 1937. This will be of the moon, when that body enters the shadow of the earth, and happens on November 18. This will not be total, but partial, as the shadow will only cover about a tenth of the moon's diameter. On May 11, another body will come partly between the earth and the sun, but it will be so small that telescopes will be required to view it. This will be the planet Mercury which will just touch the edge of the sun's disc and will appear as a notch. This partial transit of Mercury is very rare. The planet is so small that when it crosses the sun at all, it usually is squarely in front of the disc. However, it is of no particular scientific importance, except to check on the accuracy of the predictions of the planet's motion.

PREVENTION OF FATAL BLOOD CLOTS BY PURIFIED HEPARIN

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FATAL blood clots in the veins or arteries, the tragic consequence in many an operation and blood transfusion, may be prevented in future by the use of heparin, it appears from a report of a University of Toronto research group to the Canadian Medical Association. Members of the research group are Drs. D. W. G. Murray, L. B. Jacques, T. S. Perrett and C. H. Best, the latter a co-discoverer of insulin.

Heparin acts in two ways: (1) By making the blood clot more slowly, which would make it a valuable aid in blood transfusions where there is always danger of clotting; (2) by preventing dangerous narrowing or closing of the veins following injury to them. Heparin was first prepared from the livers of dogs by Dr. William H. Howell, professor emeritus of the Johns Hopkins University. As little as one milligram, about one hundredth of a grain by weight, will prevent clotting for an hour of about an ounce of blood, he found in his original investigations. Use of this potential life-saving remedy was limited because of lack of sufficient supply of the material in highly pure form. This has been overcome by Drs. Arthur Charles and D. A. Scott, of the Connaught Laboratories. Their highly purified heparin has been used safely and successfully in both human patients and dogs. This heparin slowed the clotting of blood from a normal of 8 minutes to a maximum period of 30 minutes.

Heparin's effect on the veins may be equally important. The veins may be thought of as hollow tubes through which the blood flows. If injury or disease makes the walls of these tubes thicker, there may not be enough room for the blood to get through, and the veins are said to be occluded. It is thought that this may be a factor leading to formation of blood clots, which would completely block the circulation. The danger from such clots depends on the importance of the vein in which they form. Heparin reduces the chance of such clots by its effect on the blood and in addition prevents the closing of a vein following injury. If injections of heparin are continued long enough in such cases the injured vein heals and there is greatly reduced tendency for it to close up after heparin treatment is stopped. Injecting heparin into a vein affects the blood throughout the entire body, making it clot less readily. Injecting it into an artery, on the other hand, produces a more local effect. This arterial injection affects the blood flowing through the particular arm or leg where the heparin was injected.

PERSUASIVE METHODS IN THE CONTROL OF SYPHILIS

SYPHILIS is being controlled by "persuasion" at the clinic of the University of Pennsylvania Hospital, Philadelphia. This new public health method of dealing with the infectious syphilis carrier is proving surprisingly

successful. Louise Brown Ingraham, social service worker, gives a full account of the "persuasive approach" in the forthcoming issue of the *Journal* of the American Medical Association. This hospital's work with syphilis carriers is being aided by a grant from the Milbank Foundation.

The clinic, by friendly sympathy, persuades the syphilis patient to disclose the identity of his recent sexual intimates. Then it convinces him that it is his duty to the community to persuade the person or persons involved voluntarily to seek a medical examination for syphilis. If the patient does not wish to approach his contacts himself, the hospital social workers take over the task, in no case divulging the source of their information.

So successful has the university clinic been that of 201 patients with syphilis, 114 identified 174 exposures. Eighty per cent. of these persons have been located, and 73.5 per cent. have been recruited for examination. The type of community—white or colored, poor or well-to-do—has little effect on the response of the individuals. Mrs. Ingraham's figures show that the communications of the social worker—office interviews, home visits, letters, etc., instrumental in the accomplishment of 128 examinations for syphilis—cost $5.22 per successful case.

The technique is equally applicable in public health undertakings, the doctor's private office, the home or the hospital clinic. The approach dips deep into the heart of the individual and society, slowly brings into the community a realization of the ominous prevalence of syphilis and makes possible a more intensive medical attack. It appeals to the ideals of the individual, maintains his self-respect and upholds his position in society. A small organization for the treatment of syphilis can, through the use of the voluntary approach, obtain a following of faithful patients who will support its chosen public health activities and assist in the spreading of intelligent syphilis propaganda.

USE OF THE ULTRA-SHORT RADIO WAVES

T. A. M. CRAVEN, chief engineer of the Federal Communications Commission and guest speaker at the First National Conference on Educational Broadcasting held in Washington on December 10, reported that the ultra-short radio wave-lengths are now being considered for addition to the practical radio spectrum.

Present practical usefulness of the radio goes down to the short waves with a frequency of 30,000 kilocycles (10 meters). Already under consideration and due for use very soon is the radio spectrum band from 30,000 kc to 200,000 kc, or to one and a half meter waves. At first glance this seems to be a tremendous increase over the present 30,000 kc. However, again we find distinct limitations because of the increasing demands and because of new developments. Acceptable television will need over half of the now untapped radio frequencies. Blind landing systems for airplanes, with their great increase in aerial safety, would use these wave-lengths. Facsimile transmission by radio would likewise require this radio band. Finally there is the growing use of light-weight portable transmitters in the police and forestry services, which require the use of these new short waves. At a recent hearing of the Communications Commission the preliminary estimate of the radio needs of the government services alone was such that one half of the newly developed portion of the radio spectrum would be required.

Speaking with Mr. Craven on the program were Dr. C. B. Jolliffe, former chief engineer of the commission and now with the Radio Corporation of America, and Dr. Alfred N. Goldsmith, well-known radio consulting engineer of New York City.

All three men, without stating so in so many words, pointed out that the dream of some educators to have 15,000 stations serving 127,000 school districts was a hopeless impossibility. They stressed the technical and international aspects of broadcasting and emphasized that every time a new radio band is made available there seems to be room for everybody who wishes to operate a radio transmitter; but that the crowding ever becomes greater on the radio waves.

THE STUDY OF RADIO AUDIENCES

DR. HENRY C. LINK, of the Psychological Corporation, New York, told a discussion group at the First National Conference on Educational Broadcasting at the Mayflower Hotel, Washington, on December 11, that a million dollars a year is being spent by business executives to find out how many people listen to their radio broadcasts. But still they do not know anything about the extent to which their listeners are really paying attention to the program.

Sponsors of educational programs also have a need to study their audiences. Even the rough measures now obtained by the sponsors of commercial programs of the numbers listening in are of value in planning programs to meet the interests of listeners. He told of a survey made by means of personal interviews in farm homes, rural town homes and cities. The audiences found for the educational programs at these centers were pitifully small in comparison with the audiences for commercial or sustaining programs, even when the relative power of the stations is borne in mind. On the other hand, an amazingly large number of commercial programs were described, by many of these people, as being programs of general educational value.

Professor Edward S. Robinson, of Yale University, reported at another session of the conference that mere repetition may not deserve the faith that radio advertisers have in it as a means for impressing audiences. The discoveries of psychologists have great importance to successful educational broadcasting. The matter of repetition he cited as an example. Rare is the occasion upon which a new idea is grasped from a single presentation. Yet the ideal of educational broadcasting is not to be gained from the often fatiguing and annoying repetition in which the commercial advertiser has such faith. The results obtained from many studies of learning indicate that the optimal repetition varies with the material presented, with the audience and with many other factors.

Professor Robinson indicated that arguments over whether the radio is as effective as the printed word or some other means of communication are pointless. The

radio is being used and will continue to be whether or not it is as effective as some other method of communication. The psychologist can aid in the improvement of broadcasting technique.

GERMANY'S MINERAL RESOURCES

THE threat of war and lack of foreign exchange are driving Germany into a position where millions of marks each year are diverted into subsidies in the mineral industries, reports Charles Will Wright, foreign mineral specialist at the Consulate General, Berlin, to the U. S. Bureau of Mines in an analysis of Germany's mineral resources.

Petroleum products, iron ore, manganese, chromium, tungsten, bauxite, copper, lead and sulphur are only a few of the raw mineral essentials that Germany must obtain either by import or by costly subsidized production at home. Low-grade deposits of minerals are being worked by highly efficient but extremely costly plants which would be worthless if international trade in its former sense reappears. Synthetic gasoline, as an example, is being made in large amounts from coal by the Bergius process but the cost of this fuel in Germany is four times the world price. Coal is the major mineral blessing enjoyed by Germany, for the nation owns 39 per cent. of Europe's coal reserves to-day, even though this is an appreciable drop from the pre-war holdings of 50 per cent.

Characteristic of Germany's mineral troubles is copper. There is but one worthy copper mine in the country and this has been subsidized in the last three years to the extent of 38,000,000 marks. Sulphur, whose main function is to be turned into carbon bisulphide for use in rayon manufacture and for vulcanizing rubber, comes half from by-product production in Germany and half from imports. High duty brings the price of the latter up to that of the internal product. Of all the nonferrous metals zinc is the only one which Germany appears to have in quantities sufficient to supply ultimately its domestic needs. Tin and antimony can be obtained by import only. The situation for lead is more encouraging and it is hoped that through government aid the present imports of lead and lead ores can be reduced from the present two thirds to one third of the requirements. Although Germany is the largest producer of aluminum in the world, only a fraction of the production comes from native sources. Hungary, Yugoslavia, France and Italy are the principal sources of the aluminum ore imported by Germany.

ITEMS

MARCUS AINSWORTH, statistical editor of the trade journal *Automotive Industries,* announces that motor vehicle registration has reached an all time high during 1936, with 28,427,077 vehicles listed. Previous high was 26,657,072 in 1930, just after the peak production year of 1929. The 1936 totals split into 24,459,940 for passenger cars and 3,964,137 for trucks and buses. Registration of commercial vehicles gained 11 per cent. over 1935 figures and passenger cars were up 8 per cent. Utah was the leading state in registration increase with a gain of 26.8 per cent. The District of Columbia came next with an advance of 26.6, followed by Nebraska with 21.9, Indiana with 20.8, New Mexico with 17.8 and Connecticut with 14.9 increase. New York state maintains first place in total registration with 2,464,400 vehicles, California being a close second at 2,425,000. Pennsylvania, Ohio, Illinois, Texas and Michigan follow in that order.

INCOMPATIBLE human couples frequently fail to have children, though if they are divorced and find themselves new mates the new marriages may be fertile. Similarly, some of the plants investigated in research at the New York Botanical Garden, under Dr. A. B. Stout, could not produce seed when crossed with each other, but when used in hybridization experiments with different plants reproduced quite normally. This physiological difficulty between particular strains of plants has been given the technical name, protoplasmic incompatibility. A graphic display illustrating these conclusions has been prepared for display by the Women's and Professional Division of the Works Progress Administration.

LACK of the fertility vitamin E may lead to the development of cancer, it appears from experiments with chicks reported by F. B. Adamstone, of the University of Illinois, to the *American Journal of Cancer.* The results obtained by Mr. Adamstone apply only to chicks and to one type of tissue. They are, however, significant and may furnish an important clue to the cause of at least one type of cancerous disease. When the chicks were fed for prolonged periods on a diet normal in all respects except for its complete lack of vitamin E, all the chicks died, some of them suddenly, others after an illness. Examination after death disclosed the growth of new, cancer-like tissue which was destroying the normal tissue of liver, heart, pancreas, gizzard, spleen and lungs. The tumors belong in the class known as lymphoblastoma and appear very much like the tumors found in typical cases of leukemia in the fowl, though Mr. Adamstone makes no claim that the two conditions are identical.

BALLOONS carrying robot radio mechanisms that signal back to earth the weather aloft may soon be used regularly to replace the present upper air airplane observations when weather makes flying impossible. For the first time the radio meteorograph record has taken the place of the weather airplane in gathering U. S. Weather Bureau reports. The weather was too bad for an airplane ascent. The Harvard Blue Hill Observatory let loose a radio meteorograph in dense fog, rain and northeast wind and obtained a record to 30,000 feet. The radiometeorograph showed that the cloud from which the rain was falling extended up to 7,500 feet and that the temperature was below freezing above 5,000 feet. A second cloud layer 600 feet thick was encountered at 10,000 feet. Above this the air was quite dry indicating clear skies and excellent flying conditions. At 25,000 feet aloft the temperature was 36 below zero.

SCIENCE NEWS

Science Service, Washington, D. C.

SCIENTIFIC EVENTS OF THE YEAR

Physics

ONE of the fundamental forces of nature—the binding energy between the cores of two hydrogen atoms—was measured by Drs. M. A. Tuve, N. P. Heydenburg and L. R. Hafstad, Carnegie Institution of Washington.

First synthesis of a naturally occurring radioactive element was achieved in atomic bombarding experiments on bismuth by Dr. J. J. Livingood, University of California.

Experimental evidence for the existence of the neutrino was found in research on cadmium, tin, indium and tellurium isotopes by Dr. Kenneth T. Bainbridge, Harvard.

Particles of 11,000,000 electron-volt energy for use in atomic disintegration experiments were produced by Professor E. O. Lawrence, University of California.

A high efficiency radio oscillating circuit said to have usefulness in television, radiothermy, extremely high voltage x-rays and for experiments in atomic disintegration was developed by Dr. William Hansen, Stanford University.

Experiments with radio waves only six inches long which travel along hollow tubes were simultaneously announced by Dr. G. C. Southworth, Bell Telephone Laboratories, and Dr. W. L. Barrow, of the Massachusetts Institute of Technology.

A long-lived artificial radioactivity of a beryllium-aluminum alloy with a half life of at least 10 years was discovered by Dr. Edwin McMillan, University of California.

The lightest solid ever made by man or found on earth was produced in the form of a light isotope of lithium by Dr. L. H. Rumbaugh, Bartol Research Foundation.

Polaroid, a cheap polarizing transparent material which will eliminate the glare of night driving and also make possible 3-dimensional color motion pictures, was introduced by the Land-Wheelwright Laboratories of Boston.

An obsolete 130,000-pound electro-magnet at Annapolis, Md., was moved to Columbia University for use in experiments on atomic disintegration.

A small but powerful electromagnet which has produced 75,000 gauss and is capable of generating a field strength of 120,000 gauss, was reported by Dr. Francis Bitter, Massachusetts Institute of Technology.

Bearing self-recording electroscopes, small balloons released in cosmic ray experiments of Professor Robert A. Millikan, California Institute of Technology, set a new altitude record at 92,000 feet (17½ miles).

The first cosmic ray radio data obtained by small unmanned balloons of Cellophane were reported by Dr. Thomas Johnson, Bartol Research Foundation.

A new experimental check on the Einstein theory of relativity by studying the motions of binary stars was advanced by Professor Tullio Levi-Civita, University of Rome.

The human skin is more sensitive to small temperature differences than are the most sensitive thermometers, reported Dr. J. D. Hardy and T. W. Oppel, Russell Sage Institute of Pathology and New York Hospital.

Intense audible sounds were made to produce light in 14 different liquids by Dr. L. A. Chambers, University of Pennsylvania Medical School.

A fortress of science, partially underground, in which experiments on atomic disintegration will be performed, was projected by the Carnegie Institution of Washington.

To supply musicians, piano tuners and instrument makers with a standard pitch "A," the National Bureau of Standards broadcast this musical note for two weeks continuously on short wave radio.

A compact 1,000,000-volt electrostatic type generator was installed at Huntington Memorial Hospital, Boston, to produce radiation useful in cancer therapy.

Improved measurements of the magnetic moments of the proton and deuton were made by Dr. I. I. Rabi, of the physics department of Columbia University.

New types of nuclear disintegrations produced by cosmic radiation were discovered through the investigation of Dr. Carl Anderson and Dr. Seth Neddermeyer, California Institute of Technology.

A test for tool-resisting prison bars by use of a small magnetic instrument was developed by R. L. Sanford, National Bureau of Standards.

Seven hours of treatment with intense sounds will age whiskey an amount equivalent to four years in the wood, reported Dr. L. A. Chambers, University of Pennsylvania.

A simple and rugged receiver of infra-red radiation was invented by the veteran Boston electrical engineer, Dr. Hammond Vinton Hayes.

A belated scientific finding from the 1935 stratosphere flight of Stevens and Anderson was the announcement that neutrons exist at altitudes of 12 miles in a report of Drs. L. H. Rumbaugh and G. L. Locher, of Franklin Institute's Bartol Research Foundation.

First rigorous proof of an extension of the long-puzzling "Waring problem" in mathematics was reported by Professor L. E. Dickson, University of Chicago.

New value for the charge on the electron (4.800×10^{-10}) electrostatic units was announced by Kelletrop of Upsala on the basis of improved oil drop technique, and agreeing within one part in 5,000 of the best value obtained by x-ray measurements.

First complete x-ray analysis of the atomic arrangement of an amorphous substance (glass) was obtained by Bertram Warren of Massachusetts Institute of Technology.

An absorption spectroscope capable of measuring a concentration of 1/10,000 of one per cent. of carbon dioxide in air was developed for plant growth researches by Dr. E. D. McAlister, of the Smithsonian Institution.

Chemistry

Artificial production by chemical methods of beri-beri-preventing vitamin B_1 was achieved by Dr. R. R. Williams and associates at Columbia University and the Bell Telephone Laboratories and Dr. J. K. Kline, of Merck and Co.

A process for preserving milk for several months by packing it under pressure with oxygen and shipping it refrigerated was developed by Theodor Hofius.

For the first time a chemical compound which contains

an enzyme as one of its components was discovered by Dr. Kurt G. Stern, of Yale.

Enzymes, the highly complex proteins that make digestion, body oxidations and other physiological processes possible, can be formed out of inactive proteins by suitable chemical changes and heating, reported Dr. J. H. Northrop, the Rockefeller Institute for Medical Research.

A synthetic substitute for wool was developed by Italian chemists from the casein found in milk, but tests in other countries indicate that the material lacks the strength and stretching characteristics of the natural material.

The first power alcohol plant in America started operations at Atchison, Kans., under the sponsorship of the Chemical Foundation and is producing ethyl alcohol for blending with gasoline as a motor fuel.

An experimental plant for making oil and gasoline from coal by the Bergius process was operated by the U. S. Bureau of Mines at Pittsburgh.

The oxygen in the air man breathes is heavier than the oxygen in the water he drinks by six parts in a million, it was shown by experiments of Dr. Malcolm Dole, Northwestern University.

The goal of military chemists for years was achieved by the invention of a smokeless as well as flashless powder by the E. I. du Pont de Nemours chemist, R. G. Woodbridge, of Wilmington, Del.

A chemical derivative of corn product wastes yields an explosive known as hexanitroinositol which is more powerful than nitroglycerin, reported Professor Edward Bartow, president of the American Chemical Society.

With tung oil chemists are now producing a "preshrunk" paint which has improved weathering properties, reported M. F. Taggert, South Bend chemist.

Mowing cotton like hay and digesting it chemically—rather than picking it in the present fashion—was advocated at the Dearborn Farm Chemurgic Conference by Professor Frank K. Cameron, of the University of North Carolina.

By passing sea water through tubes of a synthetic resin made from formalin and tannic acid, English chemists at Teddington converted it into fresh water.

A "waxing" process for bituminous coal which decreases its dirtiness was reported by the Mellon Institute for Industrial Research chemists, Dr. H. R. Fife and P. W. Edeburn.

Phthalic acid was combined with paints to reduce the action of ultraviolet light upon them.

A powerful antiseptic made from oat hulls was developed by Drs. N. M. Phatak and C. D. Leake, University of California Medical School.

A fertilizer has been produced from paper mill wastes by the Department of Agriculture chemists, Dr. M. Phillips, M. J. Goss, B. E. Brown and F. R. Reid.

Astronomy

A total eclipse of the sun, with a totality area extending from Algeria across Asia to Japan, was extensively observed on June 19.

Eclipse observations by the Harvard-Massachusetts Institute of Technology expedition showed several new coronal lines and indicated to Dr. Donald H. Menzel of Harvard a close connection between high excitation in the chromosphere and the strength of the as yet unsolved coronal radiation.

Sunspots increased in number as the cycle progressed toward the next maximum which will probably occur in 1939.

The first modern study of the granulation on the surface of the sun was made by Professor Harry Plaskett at Oxford.

Motion pictures of solar prominences were made at the McMath-Hulbert Observatory, Mich., and shown by Dr. H. D. Curtis at the Harvard Tercentenary Conference.

A new theory of the origin of the solar system was advanced by Dr. R. A. Lyttleton of Princeton.

Ionized titanium gas was discovered in interstellar space by Dr. Walter S. Adams and Dr. Theodore Dunham, Mt. Wilson Observatory.

A method for rapid measurement of the velocities of faint stars was developed by Dr. B. J. Bok and Dr. S. W. McCuskey, Harvard.

Discovery of a giant red nebula around Antares through use of a Schmidt camera at McDonald Observatory, Texas, by Drs. Otto Struve, C. T. Elvey and F. E. Roach showed that nebulae shine by light reflected from a nearby star.

Stars shining through the Orion nebula were photographed in red light by Dr. Walter Baade, Mt. Wilson Observatory, permitting a measure of the size of dust particles composing the nebula.

The "coldest" stars yet discovered were found by Dr. Charles Hetzler, Yerkes Observatory, through use of new infra-red or heat sensitive photographic plates.

Three planetary nebulae in the Milky Way were discovered by Mrs. Muriel M. Seyfert, Harvard Observatory.

Either the universe is unexpectedly small or astronomy is confronted with a new principle of nature which leaves the question of size undetermined, Dr. Edwin Hubble, Mt. Wilson Observatory, concluded from a study of the red shift of spectral lines of extra-galactic nebulae.

The maximum age of the universe is twenty billion years as estimated by Dr. Bart J. Bok, Harvard Observatory, but probably it is much younger.

A perpetual interchange of energy between light rays and stars was suggested by Professor Arthur Haas, Viennese physicist, as accounting for the seemingly endless store of energy in the stars.

An unprecedented number of novae or "new stars" were observed: Nova Lacertae sighted in June; Nova Sagittarii found in October; and two Novae Aquilae, one discovered in September and the other in October. Nova Herculis, discovered in 1934, continued bright. Two supernovae, extraordinary explosions in distant galaxies, were seen; one in nebulae of the Virgo cluster by Mt. Wilson Observatory, another in a southern galaxy on Harvard photograph studied by Dr. W. J. Luyten, University of Minnesota.

A new minor planet, discovered in February by Professor E. Delporte of Belgium, and christened Adonis, is smallest object in astronomy's annals except meteorites and came closer to earth than any other heavenly object, except possibly one or two comets.

A new member of the family of Trojan planets was

discovered by Dr. K. Reinmuth at the Heidelberg Observatory.

A comet discovered by Leslie C. Peltier of Ohio achieved naked eye brilliance, while other comets discovered were Kaho's comet, Jackson's comet in Aquarius.

Sudden changes in radio transmission were linked to simultaneous changes in terrestrial magnetism, earth currents, and ionosphere ionization, and the cause found in simultaneous solar eruptions, in a world-wide study of radio fadeouts by Dr. J. H. Dellinger, National Bureau of Standards.

The 200-inch glass disk for the world's largest telescope finished cooling at Corning, N. Y., and was shipped to Pasadena, Calif., for shaping of the reflecting surface.

The new observatory on Mt. Palomar, Calif., was begun, with construction of building for the 200-inch telescope, establishment of two-way radio telephone link with Pasadena, construction of an airport, and taking of astronomical photographs with a pilot telescope.

A two-and-one-half-ton battery of three star cameras began to photograph the Milky Way at the Wynnewood, Pa., observatory.

A process of evaporating aluminum upon telescope mirrors was developed by Drs. John Strong and E. Gaviola, California Institute of Technology, to replace costly and lengthy grinding now necessary in shaping such mirrors.

A guiding mechanism for telescopes using photoelectric cell and amplifiers to detect and amplify star light a billion billion times was devised by Drs. A. E. Whitford and G. E. Kron, of Washburn Observatory, University of Wisconsin.

Earth Sciences

The year was one of violent climatic contrasts: The Midwest and Northwest suffered from the coldest and snowiest winter on record, followed by the hottest summer and the worst drought; destructive floods visited the East and South.

The U. S. Coast and Geodetic Survey and the Jesuit Seismological Association investigated twenty-four earthquakes on which observatories in the United States, Canada and the Philippines transmitted data through Science Service.

Discovery of several great submarine canyons off the Atlantic and Gulf coasts was reported by Professor Francis P. Shepard, University of Illinois.

Dr. C. S. Piggot, of the Carnegie Institution of Washington, perfected a "bottom sampler" for bringing up cores of ocean bottom material from great depths.

Quantitative treatment of convection in the interior of the earth was initiated by Dr. C. L. Pekeris.

The U. S. Submarine Barracuda carried an expedition into the Caribbean to measure gravitational anomalies.

A new method for determining age of rocks by their helium content was announced by Dr. William D. Urry, Massachusetts Institute of Technology.

Critical measurements of electrical resistance of various rock formations were made by R. H. Card, American Telephone and Telegraph Company.

Electrical prospecting methods were introduced in the anthracite mining region.

First dinosaur fossils ever discovered in California were found by a high school student, Allan Bennison, and were collected and studied by C. J. Hesse and S. P. Welles, University of California.

Fossil remains of a dragonfly nearly 2½ feet long were found in the Permian of Kansas by Dr. Frank M. Carpenter, Harvard Museum of Comparative Zoology.

A "missing link" of the tapir family is represented by fossils found in Wyoming and reported on by Dr. Erich Maren Schlaikjer, Brooklyn College.

A fossil fish head nearly six feet long, found near Cleveland, was mounted and placed on exhibition at the Cleveland Museum.

A full-size relief model of a Baluchitherium, largest land mammal that ever lived, was prepared at the American Museum of Natural History.

Notable fossil finds were reported from Arizona by the National Park Service, from Texas by the University of California, from Georgia by the Georgia State Geological Survey, from Wyoming by Princeton University and the University of Wyoming, and from interior Asia by the Institute of Evolutional Morphology and Paleozoology of Moscow, U.S.S.R.

The U. S. Weather Bureau undertook a systematic examination of all proposed methods of long-range forecasting.

The U. S. Weather Bureau arranged to test air movements during hurricanes, by launching large numbers of sounding balloons in the hurricane area in the South.

A laboratory in which winter weather can be artificially produced was established in the U.S.S.R.

As winter closed in, renewed drought and dust storms in the West again became menacing.

Biology

First stages in embryonic development of rabbit ova were started by treatment of unfertilized ova with chemicals and heat, in the laboratory of Dr. Gregory Pincus, Harvard University.

Fruits without seeds were formed by unpollinated flowers when growth-promoting acids were applied to their ovaries, in experiments by Dr. Felix G. Gustafson of the University of Michigan.

Dr. Ross G. Harrison, of Yale University, showed that the polarity of protein molecules brings about proper relationship of various parts of the animal body during early embryonic development.

Production of a genuine unicorn bull, through transplanting the horn buds to the center of the head, was announced by Dr. W. Franklin Dove, University of Maine.

Transplanted salamander hearts lived and continued beating in experiments by Drs. W. H. Wright and H. H. Collins, University of Pittsburgh.

Successful transplantation of a leg from one white rat to another was accomplished by Dr. J. V. Schwind, Loyola University School of Medicine, Chicago.

Foreleg bones of rats grew in the animals' brains, when transplanted in embryo stage by Dr. R. A. Willis, Alfred Hospital, Melbourne, Australia.

Visual purple, an eye pigment essential to vision, was regenerated under controlled conditions by Professor Selig Hecht, Columbia University.

Elaborate apparatus for rearing animals and plants totally free of any kind of microorganisms was perfected at Notre Dame University by Professor J. A. Reyniers.

five other gases are furnished to the colleges and industrial research laboratories. Reducing valves, gauges, needle valves, flow gauges and accessories will be shown.

EXHIBIT OF METEOROLOGICAL APPARATUS AND ACCESSORIES

Booths Nos. 17 to 23

In view of the growing importance of dynamic meteorology, due largely to rapid advances in aeronautics, it has appeared desirable to give preference to apparatus recently developed for use in research and to instruments of historic value. Equipment more or less standardized for use at climatological stations is displayed in the exhibits of manufacturers who also have contributed generously to the scientific exhibition.

Committee on Meteorological Exhibits:

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Aerological Apparatus

Blue Hill Meteorological Observatory. The main theme of this exhibit will be the new Harvard radiometeorograph and historic aerological instruments developed by the observatory, including the first thermograph lifted by a kite in 1894 and the Fergusson four-element kite-meteorograph used last on Mount Washington in 1934. There will also be a sensitive anemometer for measuring rapid changes of velocity.

The radiometeorographs are of two types, one of which, pressure-driven, has two elements, and the other, clock-driven, has three elements. In the latter, four silver needles, three of which are operated by the elements measuring pressure, temperature and humidity, contact a fine helix of platinum thread and bakelite caused to revolve by a temperature-compensated clock so that four ultra-high-frequency radio-signals are emitted every 30 seconds. The meteorological elements are covered with a sun-shield, the clock, radio-transmitter and batteries are secured in a balsawood box and the whole is covered with insulating material. The total weight is but 600 grams. The meteorological portion and general assembly were designed by Dr. K. O. Lange, the radio by A. E. Bent and the clock by the Chelsea Clock Company. The unit cost is about $32.00 in small quantities. The meteorological elements are standardized in a chamber designed by Dr. Lange for the simultaneous reduction of temperature and pressure, respectively, to −78° C. and nearly a vacuum. During an ascension the instrument is attached by its antenna, string and rubber cord to one or two light-weight latex balloons developed by the Dewey and Almy Chemical Company. The signals received at the ground are amplified and recorded on a moving plate. Some 60 ascents, two of which attained a height of about 32,000 meters (20 miles), have been made to bring the radiometeorograph to its present state of development.

The instrument will be shown in operation, recording the height, temperature and humidity transmitted from a balloon rising at a distance from the booths.

The National Bureau of Standards, and the United States Weather Bureau. This exhibit will include models showing the early stages of development of radiometeorographs and other instruments developed at the two institutions, specimens of the Duckert, Moltchanoff and Vaisala instruments from European countries and samples of light-weight "B" batteries developed by various manufacturers for this service. Other aerological apparatus from the Weather Bureau will include: One Marvin kite-meteorograph, one Fergusson balloon-meteorograph, one Friez aerometeorograph and one anemometer of new design having 4 beaded cups and newly designed bearings and contacts.

The principal feature of the exhibit will be the radiometeorograph in operation. A balloon unit will be set up at some distance from the Auditorium and signals received from it will be received at the exhibit where an attendant will explain the equipment.

J. Patterson, Controller of the Meteorological Service of Canada, contributes a visual-signaling meteorograph for use with ballons-sondes at heights up to about 4,500 meters. Lights actuated by a battery flash for each change of 2° F., of temperature and every 30 mb fall of pressure; values of these elements are determined from observations of the rising balloon and instrument by means of a theodolite. This meteorograph is very light, can be lifted by a small rubber balloon and costs only $6 or $7.

The Julien P. Friez and Sons Company, Inc. In addition to the large exhibit of meteorological and climatological apparatus by this company in its booth the special display of instruments for research will include a low-torque 3-cup anemometer designed specially for evaporation; new wind-direction and velocity equipment as supplied for naval vessels; a direct-reading hand-anemometer of a 3-cup type; a new magnetic drag type direct reading velocity-indicator; a new aerograph; possibly an anemograph standardized for velocities up to 200 miles an hour —and other instruments believed to be of interest to the meeting.

R. Fuess, Inc., New York, (representing R. Fuess, Berlin, Germany). Balloon-theodolite, for observing the altitude and azimuth of balloons; the Moltchanoff calculator accompanying the instrument permits the calculation of the observations including vector additions during an ascension. The Wigand-Koppe-Fuess Meteorograph for Aircraft records simultaneously air-temperature, atmospheric pressure, humidity of the air and wind-velocity. It is stream-lined and of durable construction so that it may be carried on airplanes. The Wigand Visibility Meter provides an objective determination of visibility which, up to the present, has been judged by eye-estimate, a method involving a large degree of personal error.

Massachusetts Institute of Technology, Department of Meteorology.—Balloon-meteorograph of the Jaumotte

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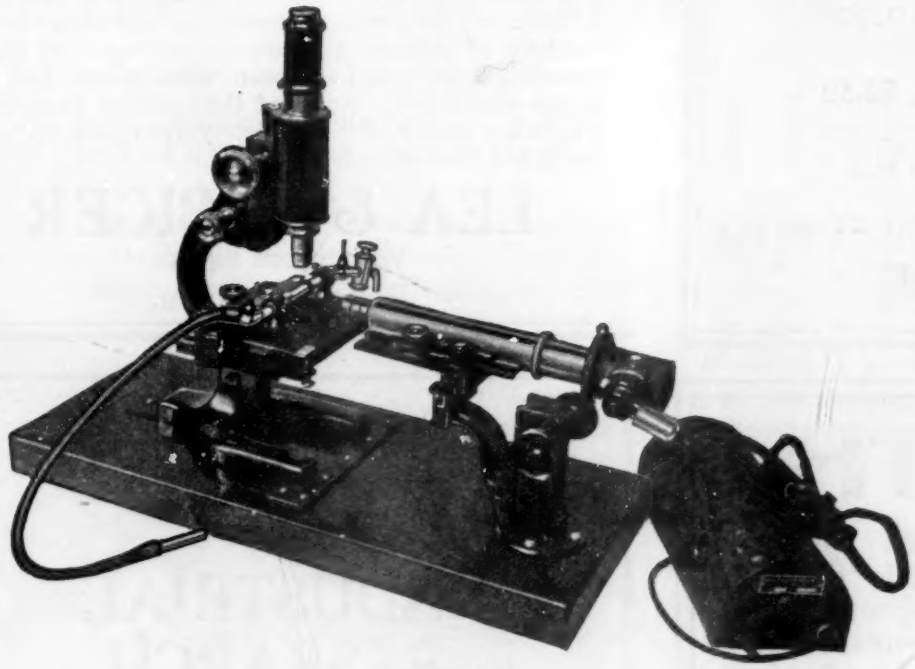

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* * * *

Subscriptions at $3.50 for the year 1937 may be sent to the Secy.-Treas., Prof. S. A. Courtis, Univ. Michigan, at Ann Arbor. Publication inquiries may go to the Managing Editor, Prof. N. J. Berrill, McGill University, Montreal, Canada. Other details may be gotten from SCIENCE, of Nov. 13th or the Chairman of The Board, Dr. F. S. Hammett, Provincetown, Mass.

GLANCES AT INDUSTRIAL RESEARCH

by Edward R. Weidlein
and William A. Hamor

A remarkable story of the development and management by the Mellon Institute of the Industrial Fellowship System as a contributing and productive force in the progress of industrial research. A study of great significance to the educators and business men of to-day and to-morrow.

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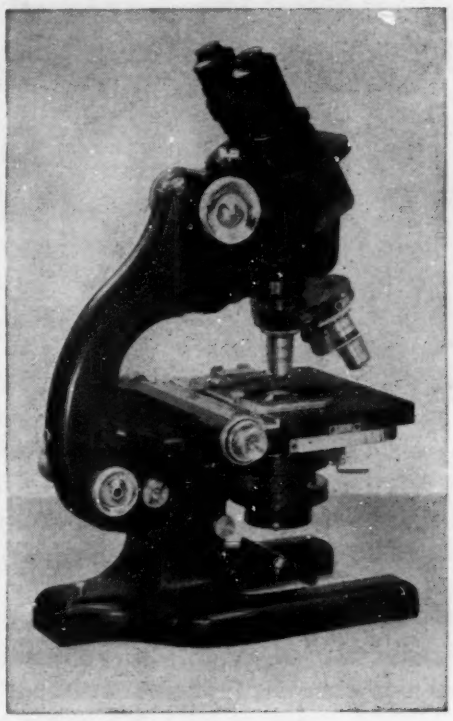

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PREVIEW OF THE ANNUAL SCIENCE EXHIBITION

In connection with the Annual Meeting of the American Association for the Advancement of Science, Atlantic City Auditorium, Atlantic City, New Jersey, December 28, 1936, to January 1, 1937

By Dr. F. C. BROWN
DIRECTOR OF EXHIBITS

THE Annual Science Exhibition is a feature of the annual meetings of the American Association for the Advancement of Science. It is safe to say that those in attendance will want to spend their free time in the exhibit hall, on the main floor of the Auditorium. Members may find their friends and their family around the exhibits or in the lounge. The National Geographic Society has honored the association by making arrangements to place the gondola of the famous stratosphere flight in the middle of the lounge. Also this society will hang a painting (15 by 36 feet) of the stratobowl at one end of the exhibit hall. These may be taken as indication that the color and performance this year will be extraordinary.

Three fields among the association's activities will be especially stressed, and may well be a pattern to other sections of the association for future meetings. One will be the astronomy exhibition, under the chairmanship of Dr. H. T. Stetson. Another comprises the meteorological displays and demonstrations from the leading institutions of the country. Mr. S. P. Fergusson is chairman for these. The third group will be the medical and related sciences under the advisory chairmanship of Dr. William Charles White.

The Science Library will more nearly show the year's production of books on science than hitherto. The catalog, classified and printed in the January issue of the *Scientific Monthly*, will be available at the exhibition.

One of the exhibits of special interest will be the radio meteorograph developed by the Bureau of Standards and the Weather Bureau, the demonstration of which will be in continuous operation throughout the meetings.

Altogether the exhibits of institutions, individuals and of private manufacturing, commercial and publishing concerns will be more comprehensive than ever before, and it is hoped that there may be a large registration of members to show appreciation. The following brief description furnishes only an intimation of the scope and interest of the exhibits.

C. G. ABBOT
Smithsonian Institution
Booth Nos. 91, 92

USING the concave cylindric parabolic mirror of 6 feet by 2 feet which he exhibited at St. Louis a year ago and the four 250-watt electric lights to take the place of the sun for indoor exhibition, Dr. Abbot employs a simple focus tube, consisting of an inner and outer pyrex wall with high vacuum between, and a barrier tube to delay the loss of heat by radiation from the inner tube outwards. The focus tube, in short, is like a Dewar flask, except for the barrier tube between the walls, and like a Dewar flask is closed at one end. A driving mechanism is provided whereby the mirror is rotated at the rate of one revolution in twenty-four hours. The rate is regulated by a synchronous motor through a worm-wheel mechanism. The radical change in the apparatus consists in the introduction of the flash steam boiler principle with an automatically regulated flow of water, so that a constant steam pressure is maintained.

THE AETNA CASUALTY AND SURETY COMPANY
Hartford, Conn.
Booth Nos. 34, 35

A demonstration of two mechanical devices originated and displayed by the Aetna Casualty and Surety Company as part of its comprehensive program for the promotion of greater highway safety through public education. The Aetna Reactometer measures in eighths of a second the mental and muscular reaction time required by the person being tested to respond to a visual stimulus by lifting his foot from the foot throttle and pressing on the brake pedal. The Aetna Steerometer records an individual's promptness and accuracy in responding through his hands to visual stimuli similar to those encountered in driving a car. One's percentage of accuracy is automatically recorded by this interesting apparatus. A. A. A. S. members will be given the opportunity of checking their reactions in these two important departments of driving skill.

AJAX ELECTROTHERMIC CORPORATION
Trenton, N. J.
Booth No. 83

Ajax Electrothermic Corporation will display a 1 kw high frequency converter with several small furnaces for heating to high temperatures and for melting metals. Literature and bibliographies of technical papers bearing on high frequency heating will be available.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE
Booth Nos. 24, 25

This exhibit is intended to call particular attention to forthcoming meetings of the association and to display some interesting facts about the meeting places. The 1937 summer meeting will be held in Denver from June 21 to 26, and the 1937 winter meeting will be held in Indianapolis from December 27, 1937, to January 2, 1938.

AMERICAN DIETETIC ASSOCIATION
Booth Nos. 66, 67

A portrayal of the field of work of the American Dietetic Association will be exhibited, with specific reference to recent research and emphasis upon the normal diet. Miss Anna E. Boller is chairman of the committee on exhibits.

AMERICAN INSTITUTE OF PHYSICS
Henry A. Barton, Director
Booth No. 94

The members of the association and their guests are invited to visit the booth of the American Institute of

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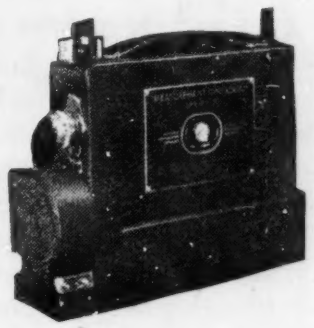

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Physics. Information concerning the institute, its five founder societies and the eight journals of physics which it publishes will be available.

AMERICAN INSTRUMENT COMPANY
Silver Spring, Md.
Booth No. 107

The American Instrument Company will display and demonstrate the Aminco constant temperature equipment, Aminco superpressure apparatus and new instruments and apparatus, developed during the last year and intended for many branches of science. Among these are a low-temperature (refrigerated) constant temperature bath, a low-velocity anemometer for measuring air flows as low as 5 feet per minute, a photoelectric photometer for measuring whiteness of powders and color and turbidity in solutions, and a mercury vapor pump of unusually high capacity.

AMERICAN NATURE STUDY SOCIETY
Booth Nos. 95, 96

The American Nature Study Society will depict the indoor and outdoor activities of its members. A library containing books with photographs or collections will be on display. There will be suggestions for interesting children in nature, an art exhibit and, it is hoped, an exhibit of a garden or a nature trail.

AMERICAN PHARMACEUTICAL ASSOCIATION
Booth No. 68

The exhibits show the division of the color solid into about 500 named compartments, the application of this system in determining color names for samples and a number of National Formulary drugs and chemicals, together with the present color names and the proposed names.

AMERICAN SOCIETY FOR THE CONTROL OF CANCER
Booth Nos. 61, 62, 63

The exhibit of the American Society for the Control of Cancer will consist of charts and living material (mice) to show the constitutional factors in the production of cancer in animals. This will be done under three headings: 1. The constitutional factors in which will be shown the incidence of cancer in different strains. 2. The subject of transplantation and its physiological factors. 3. The production of cancer by carcinogenic agents in relation to constitutional condition.

R. J. ANDERSON
Yale University
Booth No. 65

R. J. Anderson, of Yale University, collaborating with the National Tuberculosis Association, will exhibit a unique collection of biologically important chemicals produced by the tubercle bacillus and acid-fast bacteria. The collection is the largest of its kind in existence and represents the results of ten years of continuous chemical investigations. It contains a large number of new physiologically active compounds.

ASTRONOMICAL EXHIBITION
Dr. Harlan T. Stetson, Chairman
Booth Nos. 38, 39, 40, 41

The astronomical exhibit will display representative work of American observatories: space models of the nearby stars, showing the sun in comparison; evolutionary sequence of giant and dwarf stars, meteorites and educational charts and apparatus and a working model of the 200 inch telescope for Mount Palomar, Calif., loaned by the Westinghouse Company through the courtesy of the Hayden Planetarium. The Carnegie Institution of Washington will be represented by an exhibit of charts depicting results of recent researches.

BAKELITE CORPORATION
New York
Booth No. 33

Bakelite Corporation offers a depiction of what chemical research has contributed in recent years toward the improvement of various industrial materials. Stressed particularly will be the developments in the plastics industry. Among the many developments exhibited will be the new resinoid denture material "Luxene," new cementop shingles and siding, new types of Bakelite synthetic resins employed in formulating varnishes, paints and enamels, and improved molding materials for highly specialized applications. The Bakelite exhibit will not only exemplify the new materials, but it will also demonstrate their superior characteristics as compared with materials hitherto available.

BAUSCH AND LOMB OPTICAL COMPANY
Rochester, N. Y.
Booth No. 89

Bausch and Lomb Optical Company offers an exhibit of a selection of the latest developments in optical instruments. Of especial interest will be a new series of binocular microscopes and new microtomes. Various other well-known instruments will be on display for the convenience and information of those who have only this opportunity to see these instruments demonstrated.

P. BLAKISTON'S SON AND COMPANY, INC.
Philadelphia
Booth "B"

The Blakiston Company specializes in books in science and medicine. Particular attention is called to the new books of 1936. Neal and Rand, "Comparative Anatomy"; Bremer, "Textbook of Histology"—fifth edition, Youngken, "Textbook of Pharmacognosy"—4th edition; Wardle, "General Entomology"—"For a short course"; Muldoon, "Organic Chemistry for Students of the Medical Sciences"—2d edition; Heil, "The Physical World"—"For Survey Courses in Physical Science."

BUREAU OF CHEMISTRY AND SOILS, FERTILIZER RESEARCH, U. S. D. A.
The Application of electron diffraction and x-rays to Agriculture
Booth No. 93

Bureau of Chemistry and Soils will exhibit an apparatus for demonstrating the principle of electron diffraction by

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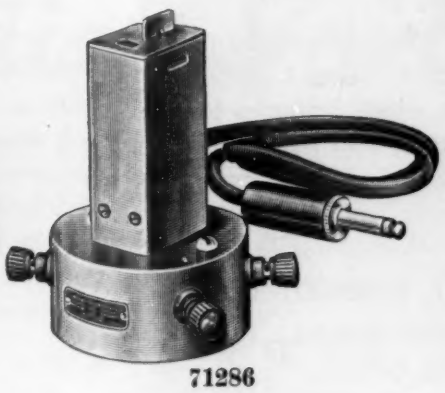

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73505

71285 IONIZING RAY COUNTER, Cenco-Alvarez, for demonstrating by visual indication the passing of cosmic rays and other ionizing rays through the counter tube. When used in connection with No. 71286 Sensitive Auxiliary Relay it makes possible the audible indication of the passing of these rays. Many interesting demonstrations of radioactivity are possible with this simple demonstration form of Geiger-Mueller counter.

The apparatus employs a modified type of Geiger-Mueller counting chamber connected into a circuit in which the ionizing impulses are sufficiently amplified to cause a small neon lamp to flash. Can be operated directly from a 110 volt A.C. source.

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73505 IMPULSE COUNTER, Cenco (Patent Pending), for Counting Electrical Impulses, with sweep hand which makes one circuit of the dial with 60 impulses, and an auxiliary dial indicates the number of circuits up to 30, and repeats. A button on the glass cover of the dial permits resetting the sweep hand to zero. A switch button in the base, which can be locked down for longer intervals, is a convenient means for starting and stopping the Counter.

The aluminum base, 10 by 15 cm, is finely finished with baked "rubber finish." The mechanism is housed in a chromium plated case. The diameter of the dial is about 4 cm ..... **Each $27.50**

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means of optical analogy. Actual electron diffraction photographs of soils, fertilizer, etc., will be exhibited. The biological effect of x-rays upon maize seedling and other plants will be demonstrated in cooperation with the Bureau of Plant Industry.

BUREAU OF ENTOMOLOGY AND PLANT QUARANTINE

Booth Nos. 51, 52

An exhibit by the Bureau of Entomology and Plant Quarantine containing colored illustrations and descriptive matter illustrating various ways in which dipterous insects cause injury to man and animals. It also includes a section dealing with the successful use of maggots and their secretions in the treatment of non-healing wounds.

BUREAU OF MEDICAL ECONOMICS

American Medical Association

Booth Nos. 69, 70

An exhibit on distribution of medical facilities, showing (by means of graphs) the number of medical schools and graduates since 1880, the increase in the number of physicians and population of the United States, the population per physician since 1886. The graphs also picture the population per physician and the percentage of physicians according to specified size of communities compared for 1906, 1923 and 1931, the relation between the percentage of population filing income tax returns, and the population per physician, the relation between the percentage of population filing income tax returns and the population per general hospital bed, and the percentage of general hospital bed occupancy.

BUREAU OF MINES

Booth No. 36

The Bureau of Mines exhibit will illustrate its work on the determination of dustiness in mine atmospheres and will feature equipment and appliances developed by the Bureau for this purpose, together with respiratory protective devices tested and approved by the Bureau.

CAMBRIDGE INSTRUMENT CO., INC.

New York

Booth No. 110

A number of precision mechanical and electrical instruments manufactured by the Cambridge Instrument Company will be exhibited. This wide range of instruments will include those designed to meet the needs of engineering and research laboratories. Cambridge instruments meet almost every requirement of physical, electrical and industrial testing and research.

FRED S. CARVER

New York

Booth Nos. 54, 55

The Carver Laboratory Press for general research, produced by Fred S. Carver, will be shown in operation during the exhibit together with its various accessories, which are standardized for specific applications, in the chemical or biological laboratories.

CENTRAL SCIENTIFIC COMPANY

Chicago

Booth Nos. 87, 88

An exhibit featuring a number of new developments and improvements in equipment covering the various branches of science, particularly physics, including apparatus for improved methods in hysteresis measurements and other phenomena; new and improved apparatus for demonstration and laboratory experiments in heat; new instruments and demonstration pieces for illustrating the various phenomena in fields of electricity and light, and new instruments associated with and used in connection with modern physical research.

CLAY-ADAMS COMPANY

New York

Booth "F"

The Clay-Adams Company will have an interesting display including a new group of zoological models, other biological models, charts and life histories. Anatomical models, neurological and osteological material will also be included in this exhibit.

COMMONWEALTH OF VIRGINIA EXHIBIT

Sponsored by Virginia State Commission on Conservation and Development

Richmond, Virginia

Booth No. 85

Exhibit will consist of a large scenic and historic map of Virginia (5 x 10 feet); photographs of some educational institutions in Virginia, places of scenic and historic interest, of some manufacturing and industrial plants (chemical, rayon, etc.), of some natural wonder features of Virginia and of recreational areas (state and national parks, Hot Springs, Virginia Beach, etc.). Moving pictures with variation or sound are expected to be shown, one reel each on George Washington in Virginia, Shenandoah National Park in Virginia and seven reels on Movie Travelogue of Virginia.

ARTHUR H. COMPTON

University of Chicago

Booth No. 108

Charts showing some of the more interesting results of recent surveys of the intensity of cosmic rays.

COSMIC RAY APPARATUS USED IN EXPLORATION OF LATITUDE AND ALTITUDE

By the Bartol Research Foundation

Booth No. 75

The Bartol Research Foundation will exhibit apparatus designed by Dr. Johnson for shipboard observations of

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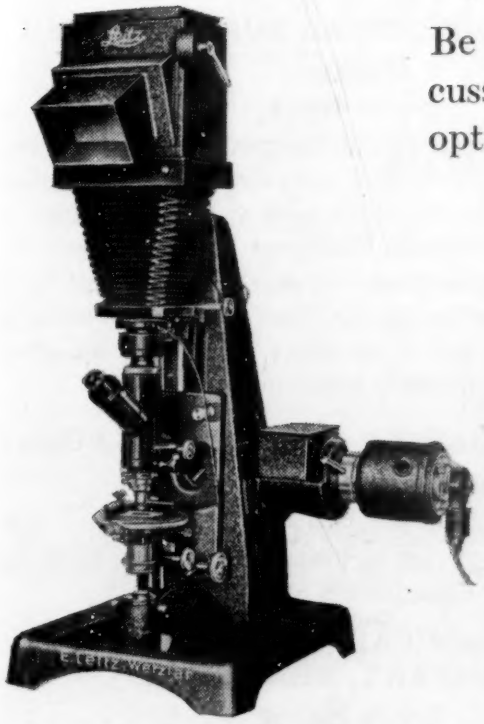
A Cordial Invitation

to visit our Exhibition of Optical Instruments at the Annual Meeting at Atlantic City, Booth C, Main Auditorium

Scientists and Research Workers in every field will find among the Leitz optical instruments the apparatus each needs to carry on his work. The Leitz line covers many types, each with a full complement of accessories. The four illustrated here are but a few of the many to be exhibited. In addition, there will be one of Leitz's recent important developments: the **Tyndallometer,** a photometric instrument for measuring the dust content of air by visual observation.

Be sure to call. Our technicians will be glad to discuss with you microscopy and other applications of optical instruments and accessories.



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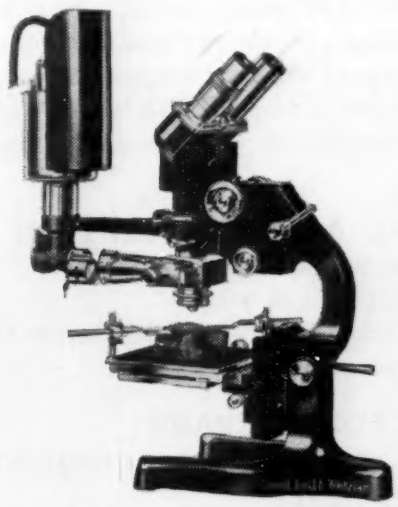

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variations of cosmic ray intensity with altitude, with special reference to the stratosphere. A cosmic-ray apparatus designed and used by Drs. Swann, Locher, Danforth and Montgomery for investigation in the stratosphere in the recent Geographical U. S. Army flight and other apparatus designed by Dr. Swann for cosmic-ray measurements in the stratosphere will also be shown.

DENOYER-GEPPERT COMPANY
Chicago
Booth No. 82

Exhibition of a selection of New American-Made Anatomical Models and New General Biology Charts. Also new, interesting and useful Demonstration Mounts for Biology.

EASTMAN KODAK COMPANY
Rochester, N. Y.
Booth No. 53

Kodachrome, the Eastman color process, will be explained and demonstrated, and its various applications to science will be shown. The Kodak Recomar and the Kodak Bantam Special will be exhibited with other Kodaks, with emphasis upon the versatility of the Recomar and Bantam Special. The coupled range finder and the Ektar lens which are parts of the Bantam Special will be explained. The several kinds of Cine-Kodaks, including the Magazine Cine-Kodak and Cine-Kodak Special will be displayed with their accessories. Pola-screens, Grenz-ray photographs, spectroscopic plates, Eastman Wash-Off Relief prints and other recently developed products will be included.

ERPI PICTURE CONSULTANTS
New York
Booth "Special"

Erpi Picture Consultants, Inc., will exhibit at the December meeting of the A. A. A. S. its library of instructional sound films in the fields of botany, zoology, geology, physics, chemistry, physiology, psychology and pedagogy. Of particular interest this year will be the new physiology and astronomy films produced in cooperation with the University of Chicago for instructional purposes at the high school and college levels.

FEDERAL BUREAU OF INVESTIGATION
U. S. Department of Justice
Booth Nos. 6, 7

Exhibit depicting the scientific work of the Bureau in connection with its law enforcement proceeding.

FORD MOTOR COMPANY
JOHANSSON GAGE BLOCK AND ACCESSORY EXHIBIT
Dearborn, Mich.
Booth No. 47

This exhibit will consist of Master sets of Johansson Gage Blocks. One set will make one million different gages in steps of twenty-five one-hundred-thousandth millimeters, and a corresponding set in inches in steps of one one-hundred thousandths. These show how international measurements of length interchange. A set of eleven gage blocks varying in size by just one millionth of an inch accompanied by an inspection certificate furnished by the Bureau of Standards will be on display.

JULIEN P. FRIEZ AND SONS, INC.
Baltimore, Md.
Booth Nos. 72, 73

Friez display to consist of full range of meteorological instruments, especially those developed for aerological use during past twelve months. Transmitters, Indicators and Recorders for wind direction and wind velocity; Micro-Barographs, Aerographs, Recorders for both local and remote temperature and humidity conditions, improved Psychrometers. Also a complete display of hydrometric instruments developed especially for the use of those whose work relates to the development and conservation of water resources.

R. FUESS INC.
New York
Booth No. 105

R. Fuess, Inc., will exhibit various types of optical instruments and accessories for the demonstration and study of optical phenomena for the educator as well as the industrialist; instruments used in the fields of physics, spectroscopy, crystallography and microscopy. The newest development for the microscopist will be explained, the "Orthophot," which is a complete unit for microscopy and projection with a built-in mirror reflex camera for microphotography. A few instruments utilizing polarized light will also be displayed.

GENERAL BIOLOGICAL SUPPLY HOUSE
Chicago
Booth No. 1

New biological teaching aids, improvements in preparation technique and attention concentrated on the biological sciences will be the three most important points in the exhibit of the General Biological Supply House. In addition to the representative in charge of the exhibit, an embryologist from the Turtox Staff will be on hand to offer explanations and suggestions to visiting scientists who are interested in slide technique.

ALFRED GUNDERSEN AND MAUD H. PURDY
Brooklyn Botanic Garden
Booth No. 102

An exhibit of drawings and diagrams relating to flower structures and the classification of dicotyledons.

HANOVIA CHEMICAL AND MANUFACTURING COMPANY, NEWARK, N. J.
Booth No. 78

An operator qualified to fabricate the most intricate of fused quartz apparatus will function during the entire period of this exhibit. It is requested that visitors make use of the service thus provided and have their orders for fused quartz executed during the exhibit and while they look on. In this way, they can secure apparatus absolutely in accord with their requirements.

Clear Fused Quartz contains less than 1/10 of 1 per

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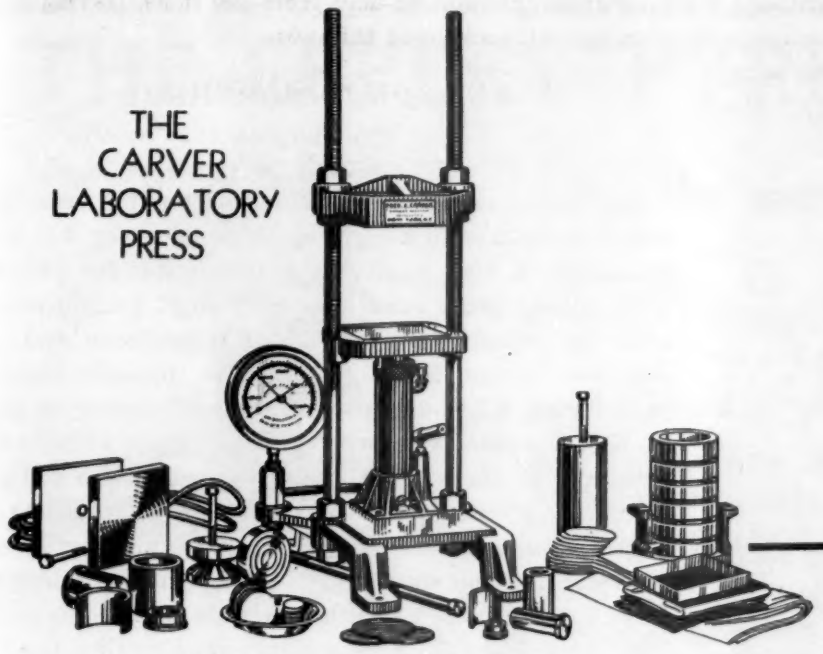

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BIOLOGICAL
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LABORATORIES

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cent. of impurities. It becomes plastic at 1750 centigrade. It has many valuable qualities of interest to chemists, engineers and physicists. It transmits ultraviolet radiations freely and is an excellent electrical insulator. It is not readily attacked by most chemical products.

INTERNATIONAL PRINTING INK CORP.

New York
Booth No. 53B

Various equipment and promotion materials will be exhibited, including specially developed devices for the aid of the printer.

KELLOGG COMPANY

Battle Creek, Mich.
Booth No. 26

Visit the Kellogg booth for a cup of refreshing Kaffee Hag Coffee. Bottle exhibits showing the stages in decaffeinizing coffee are displayed, and complete explanation of process is given. Reprints of reports covering research carried on at the University of Michigan to determine the effects of caffeine are available. The exhibit is in charge of Miss Mary I. Barber, director of home economics for the Kellogg Company.

CHARLES T. KNIPP

Department of Physics, University of Illinois
Booth No. 90

A Cold Cathode Rectifier. This rectifier, while it makes use of Hittorf's principle of limiting the development of Crookes dark space, has been improved in its efficiency, ability to stand up under continued operating conditions, and in the magnitude of the voltage and current rectified. The attending phenomena will be made visible; (a) by observing the discharge in a vacuum tube (the load), (b) by simultaneously observing the trace of the wave-form on a cathode-ray oscillograph, (c) by the characteristics of the discharge through the rectifier itself. Photographs of the various wave-forms will be on display.

LANCASTER PRESS, INC.

Lancaster, Penna.
Booth Nos. 79, 80, 81

Booth No. 2

The Lancaster Press, Inc., of Lancaster, Pennsylvania, one of the oldest scientific and technical printing concerns in America and now celebrating their 60th year in business, will have on display journals which they print for numerous affiliated societies of the American Association for the Advancement of Science. They will also display scientific and technical books which they have recently printed.

IRVING LANGMUIR

General Electric Company
Schenectady, N. Y.
Booth No. 2

Multimolecular layers of stearic acid compounds transferred to glass or metal surfaces from water solution. Several variations will be shown which depend upon the composition of the water solution. Treatment in benzene dissolves free stearic acid from the films, leaving a skeleton film of unchanged thickness.

LEEDS AND NORTHRUP

Philadelphia
Booth "E"

Exhibition of: Wenner potentiometer for measuring low temperatures to a high degree of accuracy will be in operation: A high sensitivity galvanometer for precision work, giving great sensitivity with short period, is used with the potentiometer: Shielded capacitance and conductance bridge for high precision measurements of capacitance, S.I.C. and power factor of dielectrics up to 50 KC: Speedomax recorder with Rayotube records temperatures at about ten times the speed of the ordinary industrial pyrometer. Silver-anniversary Micromax recorder—the new model of the machine universally used for recording and controlling. Among many points featured are the 10-inch length of visible chart—the exceedingly bold dial—the big-capacity, non-clogging pen.

E. LEITZ, INC.

New York
Booth "C"

E. Leitz, Inc., will exhibit a Universal Photomicrographic Apparatus Panphot, based on a new principle and of unparalleled versatility. This is a requirement of foremost importance in modern microscopy. They will also show a new Tyndallometer for determining contents of dust in air. An extensive line of microscopes and accessories will be shown.

MACK PRINTING COMPANY

Easton, Penna.
Booth No. 101

This company will exhibit scientific journals and books.

THE MACMILLAN COMPANY

New York
Booth Nos. 27, 28

The Macmillan Company plans to exhibit in the Annual Science Exhibition new and standard texts in the following fields: Biology, Chemistry, Engineering, Mathematics, Astronomy, Physics, Psychology and Home Economics. Publications related to science for the general reader and on outdoor life and gardens will also be included.

McGRAW-HILL BOOK COMPANY

New York
Booth No. 109

Advance proofs of important forthcoming books in the field of science will be on display at the McGraw-Hill booth. You are invited to see at this booth also an exhibit of recent McGraw-Hill books in the field of Astronomy, Biology, Chemistry, Forestry, Geography, Geology, Mathematics, Metallurgy, Physics and Psychology.

THE MATHESON COMPANY

East Rutherford, N. J.
Booth No. 53A

The Matheson Company will exhibit the various sizes of cylinders in which their hydrogen sulfide and twenty-

THE EPPLEY PYRHELIOMETER

for the determination and recording

with suitable auxiliary apparatus

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SOLAR RADIATION

A modified form of the Weather Bureau type described by Kimball and Hobbs in the Journal of the Optical Society of America and Review of Scientific Instruments, Volume 7, No. 9, page 707 in an article entitled "A New Form of Thermoelectric Pyrheliometer", and also in the Monthly Weather Review, Volume 51, No. 5, May 1923, page 239.

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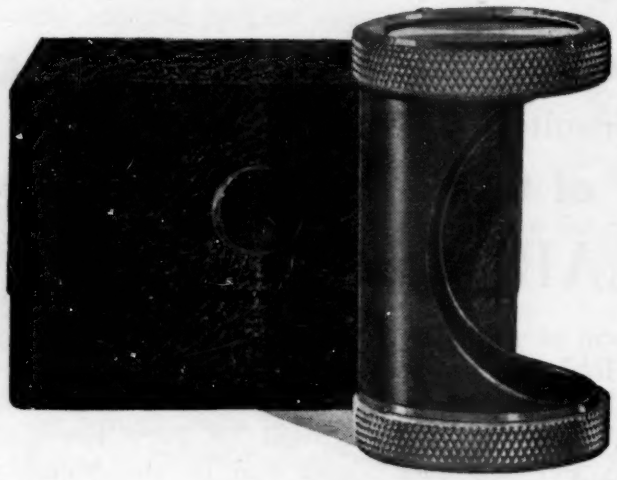

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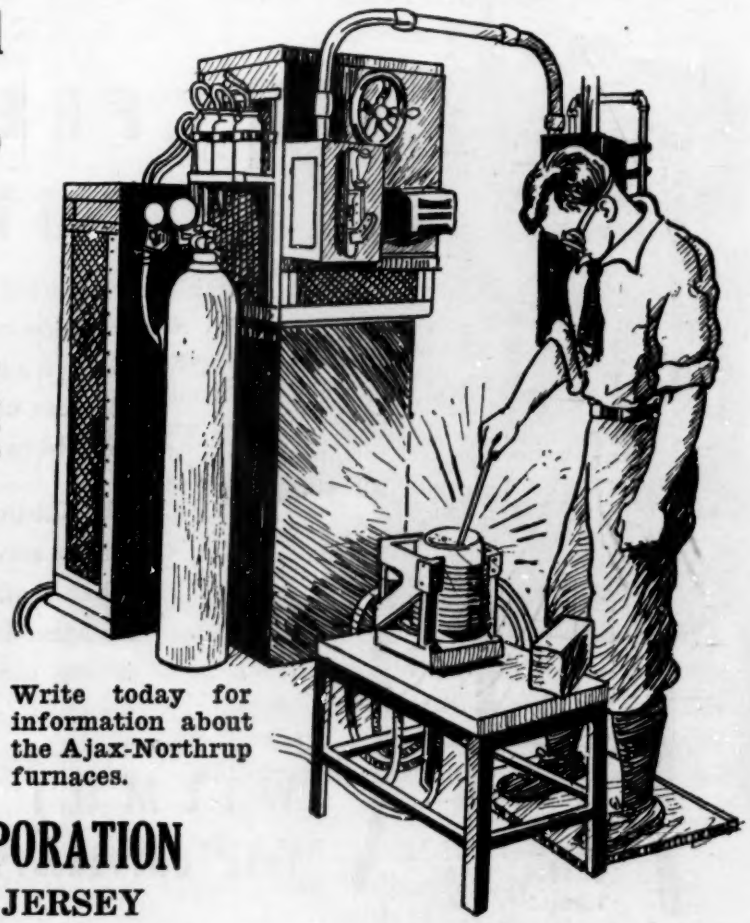

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Booth Number

ONE

At the Atlantic City A. A. A. S. meetings of 1936 will be the location of the

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Embryologists will be especially interested in the Turtox exhibit as, in addition to seeing some Turtox Embryology slides, they can discuss their preparation with Margaret H. Davidson, the embryologist on the Turtox staff who is responsible for our embryology slides.

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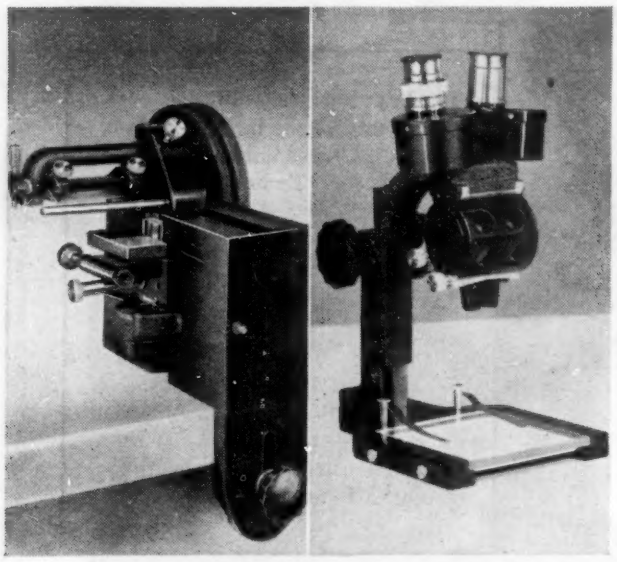

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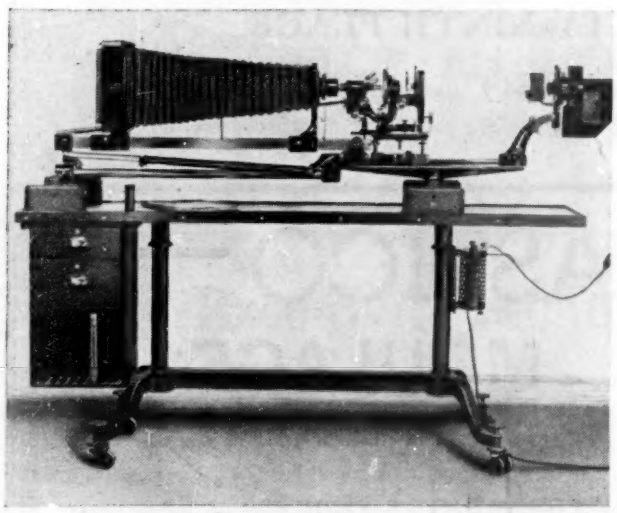

The B & L Photomicrographic Equipment with newly designed shock absorbers which eliminate vibration.

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89—

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BOOTH NUMBER 89

While you are attending the A.A.A.S. Meeting at Atlantic City, be sure to call at the Bausch & Lomb Exhibit. There you will see on display the latest developments in optical instruments and accessories for the scientist.

Several of these instruments have been redesigned since last year and the Bausch & Lomb representatives at the meeting will gladly demonstrate any instrument in which you are interested.

If you cannot attend send us your name and address so that you will be sure of getting literature on new developments as they come along. Bausch & Lomb Optical Co., 642 St. Paul St., Rochester, N. Y.

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Selected McGraw-Hill Books
to be published in 1937

AGRONOMY

Conservation of the Soil
By A. F. GUSTAFSON, Cornell University. *Mc-Graw-Hill Publications in the Agricultural and Botanical Sciences*

ANTHROPOLOGY

Cooperation and Competition among Primitive Peoples
Edited by MARGARET MEAD, American Museum of Natural History. *McGraw-Hill Publications in Sociology*

Primitive Behavior
By WILLIAM I. THOMAS. *McGraw-Hill Publications in Sociology*

BOTANY

Methods in Plant Physiology
By W. E. LOOMIS, Iowa State College, and C. A. SHULL, University of Chicago. *McGraw-Hill Publications in the Agricultural and Botanical Sciences*

CHEMISTRY

Quantitative Pharmaceutical Chemistry. *New second edition*
By GLENN L. JENKINS, University of Minnesota, and ANDREW G. DUMEZ, University of Maryland. *McGraw-Hill Publications in Pharmacy*

Chemicals in War
By LT. COLONEL A. M. PRENTISS, U. S. War Department

Food Technology
By S. C. PRESCOTT and B. E. PROCTOR, Massachusetts Institute of Technology

Quantitative Analysis. A Theoretical Approach
By WILLIAM RIEMAN, Rutgers University, and JACOB D. NEUSS. *International Chemical Series*

Absorption and Extraction
By THOMAS K. SHERWOOD, Massachusetts Institute of Technology. *Chemical Engineering Series*

GEOLOGY

Gold Deposits of the World
By W. H. EMMONS, University of Minnesota

PHYSICS

Intoduction to Ferromagnetism
By FRANCIS BITTER, Massachusetts Institute of Technology. *International Series in Physics*

Electrical Measurements
By HARVEY L. CURTIS, National Bureau of Standards. *International Series in Physics*

Measurement of Radiant Energy
Edited by W. E. FORSYTHE, General Electric Co.; Prepared under direction of a committee of the National Research Council

Electron Tubes in Industry. *New second edition*
By KEITH HENNEY, Editor, *Electronics*

Physics of Electron Tubes. *New second edition*
By L. R. KOLLER, Research Laboratory, General Electric Company. *International Series in Physics*

Send for copies on approval

McGRAW-HILL BOOK COMPANY, INC.

330 West 42nd Street, New York **Aldwych House, London, W.C.2**

type, recording temperature, humidity and pressure on a smoked glass plate after the plan of the Dines engraving meteorograph. This instrument is extremely light, weighing only 40 grams, and despite its apparent delicate construction, it has given consistent, accurate results after several ascents. In addition to being inexpensive it is very accurate; temperatures can be read to within 0.1° C. The exhibit also includes a Vaisala meteorograph and the new Spilhaus vapor-pressure recorder.

Instruments for General Use in Meteorology and Climatology

Very complete collections of standard apparatus used in meteorology and climatology are exhibited by Julien P. Friez and Sons, the Taylor Instrument Companies, R. Fuess, Inc., and others. These include equipment in use at regular and special stations of the United States Weather Bureau, the Meteorological Services of the Army, Navy, the Signal Corps, and other public and private institutions.

Dr. J. E. Church, Meteorologist of the Nevada Agricultural Experiment Station, contributes snow-sampling equipment used in the measurement of snow (depth and water-content) for the purpose of ascertaining the amount of water available for irrigation. A metal tube of any desired length up to about 20 feet (6 meters), having at one end a steel cutter, is forced into snow on the ground to cut a section or sample; the depth is read on a scale engraved on the tube and the water-content is determined by weighing the tube and contents on a scale of special design whose zero is adjusted to the weight of the empty tube.

Professor George D. Clyde, of the Utah Agricultural Experiment Station, contributes a snow-sampler designed after the general plan of the Church sampler but including a scale much lighter and more economical to manufacture than that used with the Church instrument.

Miscellaneous

The Eppley Laboratories, Inc., offer a recording pyrheliometer, an instrument recording the variations of solar radiation on a Leeds and Northrup recorder. If possible this instrument will be set up so that it will give a trace of radiation incident upon it during the meeting.

The Mann Instrument Corporation offers samples of new lubricants, two new lacquers and a medium for preventing the creeping of oil away from bearings. These products are important in the maintenance in good condition of delicate apparatus.

The Blue Hill Observatory exhibit will include the head of an original Dines pressure-tube anemometer made by the inventor and contributed by him for trial during studies of anemometers conducted between 1891 and 1896, specimens of sensitive thermostatic metals used in delicate thermographs, and balsa-wood used in sensitive anemometers.

From the Agricultural Experiment Stations of Utah and Nevada; Snow sampling outfits, one of each type. (These instruments have been developed for use in determining the amount of snow and its water-content available for irrigation in the arid regions.)

The Taylor Instrument Companies will contribute materially to the general exhibition, and will have many interesting meteorological instruments in their own booths.

Charts, Maps and Diagrams

The Blue Hill Observatory will exhibit one of the first synoptic weather-maps printed at a station of the Signal Service outside Washington, a chart of the highest, lowest and mean temperatures and the monthly precipitation during the past 96 years at Cambridge, Milton and Blue Hill, copies of records illustrating meteorological phenomena and the work and results of researches, including originals of measures of sensitivity of anemometers, chronograms of data transmitted by radio-meteorographs, etc.

The Weather Bureau will contribute a complete set of the manuscript maps made up in the forecast work of the bureau, as of the same date, including air-mass maps, as follows: Chart of Northern Hemisphere, 28″ × 28″; Map AA—Weather, 28″ × 38″; Map AA—Pressure-Change, 28″ × 38″; Cloud Chart, 18″ × 24″; Temperature-change Chart, 18″ × 24″; Upper Air Chart, pilot balloon, 23″ × 23″ A; Upper Air Chart, Airplane observations, 23″ × 23″ B; Air-mass Map, 22″ × 34″; Air-mass cross section, pasted together, totaling (for 4 cross-sections) 22″ × 40″. By way of contrast there will be included a photographic reproduction of the first official weather-map ever issued. There are also included charts in color from the Atlas of American Agriculture as follows: Average summer temperatures, average dates of first killing frost, average number of days without killing frost, average annual precipitation, and average warm-season precipitation; these charts are 16″ × 24″.

Professor J. C. Jensen, of Nebraska Wesleyan University, contributes three groups of pictures of lightning, as follows: Lightning discharges from cloud to earth showing various types of branching. Lightning discharges showing photographic reversal, or Clayden effect, and pictures of similar effects produced under laboratory conditions. Contact prints and enlargements from the series of five remarkable pictures of "ball" lightning obtained on August 30, 1930.

S. M. Serebreny, of New York University, contributes a series of graphs entitled "A Few High-altitude Runs and Some Interesting Facts about Them, Especially Above the 6,000 meter (20,000 foot) Level, as Observed at the New York University Meteorological Observatory."

METROPOLITAN LIFE INSURANCE COMPANY

New York

Booth Nos. 59, 60

Progress in Cancer Control. An exhibit of charts showing the number of deaths from cancer in the United States compared with other causes; chances at each age of eventually dying from cancer; chief sites of cancer, by age

Recent WILEY Books

Our Natural Resources and Their Conservation

A. E. PARKINS, *Editor-in-Chief,* J. R. WHITAKER, *Associate Editor,* and 20 contributors.

In non-technical style, this book gives a balanced, concrete view of resources and problems in their actual setting as a part of the organic units involved. Particular attention is given to the extent and distribution of our natural resources, and to their service in regional and national development; each problem discussed is sharply localized, being viewed as the outgrowth of natural and cultural conditions in specific parts of our country.

650 pages; 121 illus.; 6 x 9; $5.00

Introduction to Theoretical Seismology, Part I—Geodynamics

By JAMES B. MACELWANE, S.J., *Professor of Geophysics and Director of the Department of Geophysics, St. Louis University.*

This book offers a clear and competent treatment of elasticity, the propagation, reflection and refraction of elastic waves, and the paths and velocities of earthquake waves in the interior of the earth. Especially valuable are the tabulation and critical discussion of information on earth structure.

366 pages; 82 illus.; 6 x 9; $6.00

Statistical Methods in Biology, Medicine and Psychology

By C. B. DAVENPORT, *Carnegie Institution of Washington, Cold Spring Harbor, New York,* and MERLE P. EKAS.

A constantly useful desk book or handbook by means of which various statistics may be computed. Method of computing is shown, together with illustrations of some of the machines which make computation easy and rapid. This book is suitable for use as a practical reference and guide in laboratory work on variation in the field of biology, agriculture, medicine, psychology, education, commerce, physics and chemistry. The present edition is even wider in its scope of usefulness than previous editions have been. *Fourth Edition.*

216 pages; 26 illus.; 4½ x 7½; $2.75

Principles of Structural Geology

By CHARLES M. NEVIN, *Professor of Geology, Cornell University.*

The purpose of this book is to discuss, as simply as possible, the deformations of the earth. During the past few years, intensive research and field work have thrown so much light on the problems of structural geology that a thorough modernization was found necessary. An entirely new chapter on Structures Associated with Igneous Intrusion has been added. *Second Edition.*

348 pages; 163 illus.; 6 x 9; $3.50

Electronics and Electron Tubes

By E. D. McARTHUR, *Vacuum Tube Engineering Department, General Electric Company.*

A book that emphasizes the fundamental principles which govern the action of all electron tubes, with space devoted to applications to illustrate their versatility. The book is essentially non-mathematical, but includes a statement of all important equations and data for their use. This part of the work includes not only the individual physical phenomena contributing to the tube characteristics, but also the tube characteristics themselves, illustrated by data taken on typical tubes.

173 pages; 89 illus.; 6 x 9; $2.50

John Wiley & Sons, Inc., 440 Fourth Ave., New York

groups; trend of cancer death rate by site, also by age; curability of cancer of certain sites as reported in recent medical literature. The object of the exhibit is to indicate the nature of the scientific researches conducted by the company in the fields of vital statistics and of public health work.

NATIONAL BROADCASTING COMPANY

New York

Booth Nos. 31, 32

The National Broadcasting Company as a newcomer in the world of science participates as one of the agencies advancing the cause of science in the world of art.

THE NATIONAL BUREAU OF STANDARDS

Washington, D. C.

Booth Nos. 49, 50

Apparatus for Recording of Temperatures and Pressures of the Atmosphere at High Altitudes: This apparatus consists of radio meteorograph and radio receiver which successfully record measurements of temperatures and pressures of the atmosphere up to altitudes of 25 kilometers. The balloon unit is driven by a d-c motor drawing 4 milliamperes. The actual weight of the complete unit is 480 grams. The radio meteorograph unit transmits signals, representing (by their relative intervals), temperature and pressure, four times each minute. These short wave signals are picked up and recorded by the radio receiver at the receiving station. Apparatus for Demonstrating Gravitation: This apparatus is built after the pattern of the apparatus designed by Sir Charles Boys about 30 years ago for demonstrating the attraction for gravitation. Apparatus for the Development of Fundamental pH Standards: The close control of acidity or pH value has become very important in many commercial operations in order to standardize the processing quality of the products. The equipment exhibited is in connection with the development of the pH factor, one of the fundamental standards. Ionosphere Exhibit: This exhibit illustrates characteristics of the ionosphere. It includes a drawing of a 50° arc of the earth's surface with the ionosphere layers drawn to scale as measured at Washington during June, 1936. It shows how the ionization varies with height above the earth and gives the range of heights of the various layers. Graphical records typical of ionosphere measurements are included, together with graphs summarizing results obtained. One of the graphs gives data for several years, compared with sunspot numbers.

NATIONAL GEOGRAPHIC SOCIETY

Washington, D. C.

Booth Nos. 4, 5

The National Geographic Society exhibit will feature the original gondola of the stratosphere balloon *Explorer II* which attained the greatest altitude reached by man, 72,395 feet, on November 11, 1935, on a flight under auspices of the society and the U. S. Army Air Corps. With the gondola will be shown ballast bags, cameras and other equipment and scientific instruments used on the flight. Noteworthy will be enlarged photographs taken during the flight, one showing the curvature of the earth on the horizon and another the appearance of the earth below when the balloon was at its maximum altitude. A painting by Juan Larrinaga, 32 by 14 feet, showing the "stratobowl" in the Black Hills with the balloon rising from it, will be displayed. Large charts indicating some of the scientific results of the flight also will be shown.

PFALTZ AND BAUER, INC.

New York

Booth No. 104

Pfaltz & Bauer, Inc., have an interesting display of photoelectric cells and laboratory apparatus to which they have been applied. Many of these instruments are entirely new and are very valuable in scientific research. In addition—some analytical and micro-balances will be shown, including the latest development of micro-balances with quartz stick rider and mechanical manipulation of fractional weights. Also various optical instruments, including microscopes and accessories, polariscopes, etc., and ultra-filtration apparatus.

PHIPPS AND BIRD, INC.

Richmond, Va.

Booth Nos. 71, 72

An exhibit by Phipps and Bird will show certain recent advances in bacteriological and physiological apparatus resulting from the application to these sciences of modern trends in instrument practice and air-conditioning technique. The application of controlled humidity to bacteriological incubators will be featured. Physiological apparatus, powered by modern types of alternating current motors or controlled by the now widely available standard frequency alternating current, will be displayed as further illustrations of this trend.

THE POLARIZING INSTRUMENT COMPANY

New York

Booth No. "G"

Polarizing Microscope Attachment to fit any type scope; also an attachment with a rotating stage. Large area glass strain testing polariscope. Projection lantern —projects vertically or horizontally, either polarized light or ordinary light. Photoelastic Polariscope demonstrating stress determination with large transparent models. And other applications intended to demonstrate the convenience and utility of Polaroid in a few of its many commercial and scientific adaptations.

RADIO CORPORATION OF AMERICA

New York

Booth Nos. 29, 30

A special feature of the exhibit of Radio Corporation of America is a magnetron tube in which the path of electrons is actually visible, and its variation shown under different operating conditions. There has been much mathematical speculation concerning this motion, but this is believed to be the first actual demonstration and conclusive proof of what happens in a magnetron oscillator. The other elements of the R. C. A. exhibit are intended to illustrate how research and development conducted in one field frequently suggests applications of technique and devices in others. In this instance electronics, a science born of radio development, is shown to be applicable to

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ECONOMIC GEOLOGY OF MINERAL DEPOSITS

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This new text is comprehensive and up-to-date, it treats non-metallic minerals fully, discusses mining methods, and includes a description of foreign competition areas. $5.00

First Opinions

"You are to be complimented on being responsible for the publication of so excellent a book."—Charles H. Behre, Jr., *Northwestern University*

"I hope it will be possible for us to make use of this book in our courses."—T. T. Quirke, *University of Illinois*

"Fills a long felt need for a well balanced text which treats adequately both the metallic and non-metallic minerals."—Albert O. Hayes, *Rutgers University*

"This book is as fine as any I have seen, or any that is now on the market. Therefore I shall use it in my classes."—J. P. Rowe, *State University at Missoula*

"The work appears to be very meritorious."—F. M. Van Tuyl, *Colorado School of Mines*

"Covers briefly but adequately the whole field indicated by the title. The whole work is well balanced . . . and is illustrated by well chosen sketches and diagrams."—H. Foster Bain, in *Mining and Metallurgy*

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By WALTER B. FORD
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The latest revision of this much admired and standard text retains the same plan of presentation—the use of theorems to state the problems under consideration.

Much of the material has been completely or partially rewritten.

Longer chapters have been broken up to make them more flexible for class assignment.

New problems have been added; eleven of the illustrations are new or revised.

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Revised Edition

By FREDERICK H. SAUNDERS
Harvard University

The approval given to the revised edition of this text puts it in the best seller class. Two printings were sold out this fall, and we now have a third large printing ready to take care of new second semester adoptions.

"Average and proficient students who have worth-while opinions make the frequent statement that Saunders' text is interesting and profitable."—F. R. Watson, in *Review of Scientific Instruments.*

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industry in general. It is demonstrated that the electron tube can perform many tasks hitherto either impossible or attainable only in degree by much greater effort and more cumbersome devices.

THE REINHOLD PUBLISHING CORPORATION
New York
Booth No. 46

The Reinhold Publishing Corporation will have an exhibit consisting of technical and scientific books, including the American Chemical Society Monographs, Colloid Symposium Monographs, Annual Survey of American Chemistry Series, Alexander's great work entitled, "Colloid Chemistry," published in four volumes, "The Condensed Chemical Dictionary" and other reference works.

RURAL ELECTRIFICATION ADMINISTRATION
Washington, D. C.
Booth "H"

With diorama photographs, charts and other devices, the many uses for electricity on farms will be suggested by the Rural Electrification Administration. The discrepancy between 0.16 K.W. for the farmer and the 3.20 K.W. available to the city worker will be depicted and likewise the great lag in electrification on the farm as compared with automobile and telephone use. The attendant with the aid of the display and literature will explain the plan and procedure of the Rural Electrification Administration.

W. B. SAUNDERS COMPANY
Philadelphia
Booth No. 48

W. B. Saunders Company will exhibit their complete line of text books and reference volumes dealing with the biologic sciences. Of special interest will be the newly revised edition of Howell "Physiology," Sollmann "Pharmacology," and MacCallum "Pathology." There will also be advance copies of the new Arny and Fischelis "Principles of Pharmacy."

SPENCER LENS COMPANY
Buffalo, N. Y.
Booth No. 86

There will be a complete display of Spencer Lens Company apparatus. This includes microscopes, both routine and research types; microtomes; micro-lamps; photomicrographic cameras and projection apparatus. The Spencer representatives will discuss your laboratory problems involving equipment of this type.

THE STUDENT SCIENCE CLUBS OF AMERICA
Booth Nos. 97, 98

The Student Science Clubs of America, a national affiliation of science clubs in high schools and elementary college classes throughout the country, will exhibit the work of representative biology, chemistry, physics and astronomy clubs. The exhibits will attempt to show how student clubs are making science more interesting to their members through field trips, programs, publications and national broadcasts.

SUPERIOR TUBE COMPANY
Norristown, Penna.
Booth "A"

In July, 1935, the Superior Tube Company announced entry as producer of seamless tubing in various metals. In the second year the technical staff was increased and the production and wages were doubled. Eight new industries have been served during the year. The representative of this company will discuss laboratory problems involving special properties and dimensions in tubing.

TAYLOR INSTRUMENT COMPANIES
Rochester, N. Y.
Booth Nos. 76, 77

There will be displayed by the Taylor Instrument Companies of Rochester, New York, a number of instruments typical of the new advancements of those used in meteorology, and in the measurement and control of time, temperature, pressure, flow and liquid level factors in industry.

UNIVERSITY PRESSES
A Cooperative Exhibit
Booth Nos. 42, 43

Eight university presses will join in displaying their scientific and technical books and journals at the Christmas meeting of the American Association for the Advancement of Science. The cooperative presses include Oxford University Press, Cornell University Press, University of Minnesota Press, Princeton University Press, Yale University Press, Columbia University Press, University of North Carolina Press and the University of Chicago Press.

In an adjoining booth special astronomical materials will be shown, including lantern slides, films and photographs from Yerkes Observatory. In this connection the university presses will feature a display of all their astronomical titles.

D. VAN NOSTRAND COMPANY, INC.
New York
Booth No. 10

Van Nostrand Company will display its latest publications in the scientific field, which include not only text-books but reference works of general interest to science. In addition to new text-books in chemistry, physics, geology and other sciences, there will be up-to-date reference works on atomic physics, chemical analysis, chemical structure and many other special subjects of outstanding scientific interest.

WARREN-KNIGHT COMPANY
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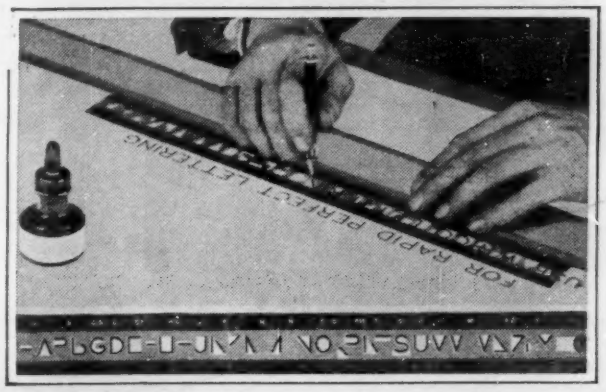

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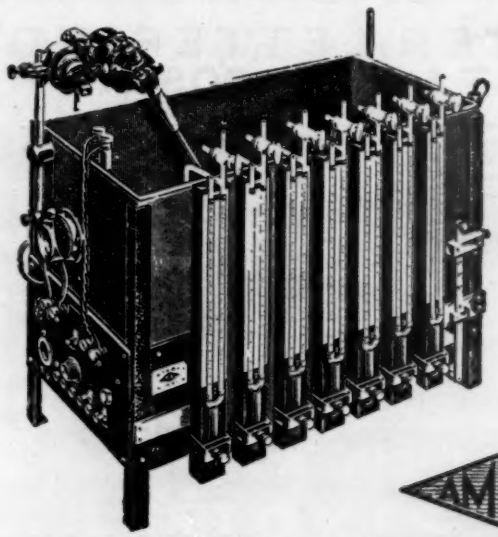

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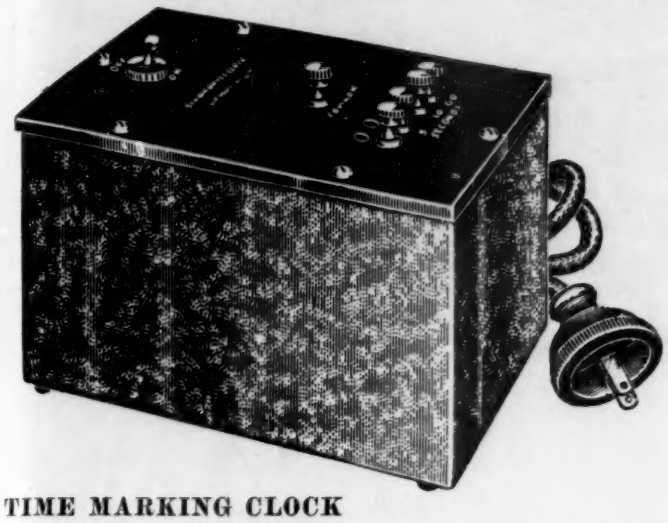

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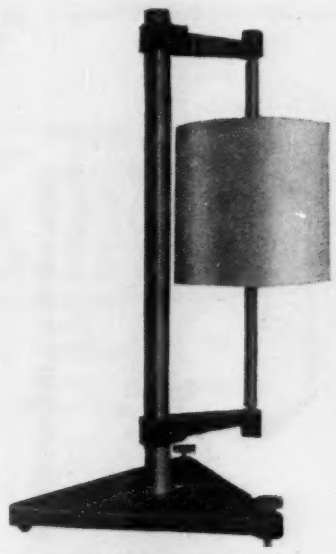

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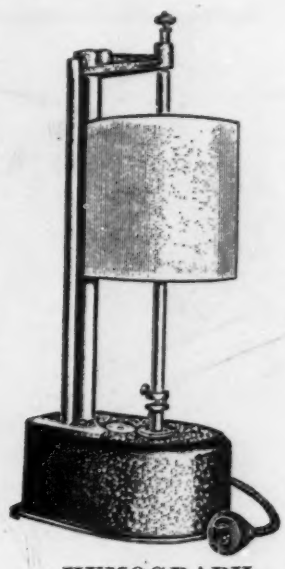

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